SUPPLEMENT

TO

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Section V.—Preventive Medicine and Tropical Hygiene.

(*Continued.*)

TUBERCULOSIS IN RELATION TO SOCIAL AND ECONOMIC CONDITIONS.

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TOGETHER with the sister Dominions of Canada, South Africa and New Zealand, Australia offers a fruitful field for studying the effects of what is or ought to be generally a healthy and natural environment on a people for the most part at least only one or more generations removed from the parent stock of the British Isles or in the case of parts of Canada and South Africa, people from France and Holland.

It is a remarkable fact that it has required a war to direct attention to the need for many reforms. Thus, after the Crimea the Royal Commission on Barracks stated that in civil life insufficient clothing, insufficient and unwholesome food, sedentary and unwholesome occupations and the vitiated atmosphere of unhealthy dwellings, all contributed to the propagation of pulmonary affections.

Again after the South African War we find the Inter-Departmental Committee on Physical Deterioration in England, whilst not finding any direct evidence of such deterioration, showed that there was much evidence of physical degeneration in considerable classes of the community. The Committee pointed out that the collection of the majority of the population in large towns was the most evident and most considerable cause in operation calculated to arrest and depress developement. The urbanization of the population there was reason to fear had not been unattended by consequences prejudicial to the health of the people, such as overcrowding, pollution of the atmosphere and conditions of employment.

After the Great War a review of the medical examination of the citizens showed that no less than one million men of military age in Great Britain were unfit for active service and it is estimated that one in four in Australia and New Zealand were in the same category.

The application of the lessons learned by the military in the 'fifties and 'sixties of last century lessened the incidence of consumption in soldiers and prisoners, among the latter the disease no longer appearing in those free from it on their reception.

Of special interest to the oversea dominions in the inquiry as to physical deterioration was the inference from the evidence of the late Professor Cunningham, of Edinburgh, the distinguished anthropologist, who after referring to the manner in which poverty with its squalor, its bad feeding and its attendant ignorance as to the proper nurture of the child, depresses the physical standard of the lower classes stated:

In spite of the marked variations which are seen in the physique of the different classes, anthropologists believe with good reason that there is a mean physical standard which is the inheritance of the people as a whole and that no matter how far certain sections of the people may deviate from this by deterioration (produced by the causes referred to) the tendency of the race as a whole will always be to maintain the inherited mean. In other words, those inferior bodily characteristics which are the result of poverty (and not vice, such as syphilis and alcoholism) and which are therefore acquired during the lifetime of the individual, are not transmissible from one generation to another. To restore, therefore, the classes in which this inferiority exists to the mean standard of national physique, all that is required is to improve the conditions of living and in one or two generations all the ground that has been lost will be recovered.

Cunningham's law has been splendidly proved by the records of the physical examinations of the school children in the dominions and not the least evidence in proof of the truth thereof is the fact that the death rates from pulmonary and miliary tuberculosis in South Africa, New Zealand and Australia are nearly half that in the United Kingdom, being per hundred thousand persons living for the Union of South Africa (whites) 41, New Zealand 52 and Australia 59, whereas for the United Kingdom the rate was 106 in 1919.

How beneficial has been the change from the overcrowded centres of the old land may also be gauged to some extent by the fact that, whilst tuberculosis is still the principal cause of death in England, it is only sixth on the list of all causes in Australia and New Zealand.

The fact, however, that in Australia 43.7% of the people are segregated in the six capital cities shows that we have not escaped from the urbanization of the population.

At the 1911 census 82.9% of the population was Australian born and 13.35% had been born in the United Kingdom.

Here it may be stated that contrary to what is sometimes alleged there are comparatively few deaths from tuberculosis among recent arrivals. Thus in 1921 out of 3,687 deaths from tuberculosis in the Commonwealth,

there were only 63 or 1.6% of persons who had lived less than five years in Australia.

An interesting fact is that both in England and in Australia the death-rates from tuberculosis have been reduced by about a half during the past forty years. Thus, in 1880 in England and Wales the death-rate from pulmonary tuberculosis was 186, whereas in 1919 the death-rate from pulmonary and miliary tuberculosis was 97 per hundred thousand living.

In New South Wales in 1880 the death-rate from pulmonary tuberculosis was 108 and in 1912 it had fallen to 54 per hundred thousand.

On examining the data for New South Wales we find that the death-rate from pulmonary tuberculosis per hundred thousand fell from 108 in 1880 to 93 in 1890, 79 in 1900, 65 in 1910 and to 54 in 1920. For other tuberculous diseases the death-rate was 31 in 1880, 33 in 1890, 18 in 1900, 11 in 1910 and 8.9 in 1920 per hundred thousand living.

In New South Wales the death-rate from tuberculosis in children under five increased considerably from 1876 to 1886.

As to sex incidence the notifications for the city of Sydney for the past eighteen years and the deaths in the metropolis show that females under twenty-five years of age suffer more than males from pulmonary tuberculosis, yet after that age the incidence and mortality among males exceeds that among females.

For the city of Sydney proper, where tuberculosis of the lungs was made notifiable in 1903, we have records of 3,357 patients up to the end of 1922. As to sex, 2,149 were males and 1,208 females and in all age groups except from fifteen to twenty-four years the number of males notified outnumbered the females. From twenty-five to thirty-four years the number of males notified to females was in the ratio of 5 to 3; from thirty-five to forty-four the number of males notified was double the number of females; from forty-five to fifty-four nearly treble, from fifty-five to sixty-four as 10 to 3 and over sixty-five nearly double.

In both sexes the incidence was highest between twenty-five to thirty-four years.

The table showing the deaths from phthisis in the metropolitan area arranged in age groups for the same period also shows that the deaths were most numerous at the same period twenty-five to thirty-four years and then descended in the following order, thirty-five to forty-four, forty-five to fifty-four, fifteen to twenty-four. An examination of the deaths for last year shows that the years twenty-five to twenty-nine were the most fatal for women and the periods thirty to thirty-four and thirty-five to thirty-nine the worst for men.

We thus see that in females there is a high early wave of tuberculosis reaching its maximum about thirty, as is also the case in England. In males the early wave is less high than in females, the maximum being reached about thirty-five and the rate does not come to that of the female rate until after sixty-nine.

The difference between the male and female rate is without a doubt chiefly due to occupation.

It is difficult in Australia to get data as to occupational mortality. Mr. H. A. Smith, Government Statistician, New South Wales, has made an inquiry for the quinquennial period 1909 to 1913 into the mortality of twenty-three occupations in which there were 10,761 deaths between the ages of twenty-five and sixty-five years.

It is interesting to note that the rates of mortality in New South Wales are considerably lower at all age groups than in England (1900-1902), the respective rates being as follows.

TABLE I.

RATES OF MORTALITY PER THOUSAND IN TWENTY-THREE OCCUPATIONS.

Country	Period	Age Groups (years)			
		25-34	35-44	45-54	55-64
New South Wales	1909-1913	4.70	7.47	13.49	23.36
England	1900-1902	6.00	10.39	17.12	35.59

As in England the most favourable death-rate is that of rural workers which is even more favourable in New South Wales than in England.

The following table provides for New South Wales a comparative summary of rates of mortality per person living by age groups in the nine occupations in which the number of lives exposed to risk exceeded 5,000 and therefore the experience is sufficiently wide to be trustworthy.

TABLE II.

RATES OF MORTALITY PER THOUSAND IN NINE OCCUPATIONS.

Occupations	Age Groups (years)			
	25-34	35-44	45-54	55-64
Rural workers	2.34	3.41	6.39	13.42
Engine makers, fitters	2.58	5.81	7.45	20.46
Miners (coal)	2.66	5.41	9.56	20.55
Railway workers	3.41	4.80	9.79	23.69
Carpenters	3.78	6.67	10.35	25.13
Mean of 23 callings	4.70	7.47	13.49	27.36
Carters	5.94	9.11	14.26	29.45
Hotel keepers, brewers	5.13	9.29	16.98	29.20
Miners (exclud'g coal)	5.75	9.49	16.98	30.36
Laborers (undefined)	17.80	25.75	41.20	87.73

The proportion of the above rates of mortality in individual occupations to the mean rate in twenty-three occupations are as shown below.

The relative salubrity of rural occupations is outstanding, the rate of mortality therein being at all ages less than one-half of the mean of twenty-three occupations which include town and city dwellers.

With regard to the mortality rate of labourers (not otherwise defined) being three times as great as the mean of all occupations, Mr. H. A. Smith states that no less

than 33.9% of the total deaths examined occurred among men classified as "labourers," although the number so classified at the census of 1911 was only 9.9% of the lives exposed to risk at ages twenty-five to sixty-five in the occupations considered.

Exhibit I. shows an analysis of the deaths of occupied males between the ages of twenty-five and sixty-five years in each of the twenty-three occupations during the period 1909 to 1913 by each principal cause. The most prolific single cause of mortality among male workers at these ages is tuberculosis which according to the figures affects printers, bootmakers and painters more than other tradesmen and rural workers and medical practitioners less.

It may be stated that occupation is a greater factor in sickness rates than overcrowding or density of population and is second only to age in this regard.

The incidence and death-rate from tuberculosis are correlated with density of population in an area and with the average number of inhabitants occupying a house or room.

This is well illustrated in the spot map of the city of Sydney showing the location of deaths from tuberculosis of the lungs during the past twenty years.

In contrast to the slight incidence of the disease in the richer class residential areas, such as Potts Point, there is the comparatively high incidence in the poorer and more squalid congested areas of the city, such as Surry Hills. There is practically no difference in these localities other than such as are traceable to social and economic conditions.

The remarkable decline in the tuberculosis rate synchronizes with improvement in the social and economic status of the general mass of the people which characterized the last two decades of last century and which has been intensified by the anti-tuberculosis campaign of more recent times. Improved housing, improved appreciation of personal and communal hygiene, reduction in the hours of labour and improved conditions in industry have made the chances of succumbing to tuberculosis much less for the present generation.

TABLE III.

PROPORTION MORTALITY RATES IN TWENTY-THREE OCCUPATIONS.

Occupation	Age Groups (years)			
	25-34	35-44	45-54	55-64
Rural workers	50%	46%	47%	49%
Engine makers, fitters	55%	78%	55%	75%
Miners (coal)	57%	72%	71%	75%
Railway workers	67%	64%	73%	87%
Carpenters	80%	89%	77%	62%
Mean of 23 callings	100%	100%	100%	100%
Carters	126%	122%	106%	108%
Hotel keepers, brewers	109%	124%	118%	107%
Miners (exclud'g coal)	122%	127%	126%	111%
Laborers (undefined)	379%	345%	305%	321%

TUBERCULOSIS IN SCHOOL CHILDREN IN NEW SOUTH WALES.

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Pulmonary Tuberculosis (clinical).

TABLE I.

INCIDENCE OF PULMONARY TUBERCULOSIS IN SCHOOL CHILDREN.

Sex	Number Examined	Number of Pulmonary Tuberculosis	Rate per 100,000
Boys	35,897	16	44
Girls	35,159	9	26
Both	71,056	25	35

TABLE II.

DISTRIBUTION OF PULMONARY TUBERCULOSIS.

District	Number Examined			Pulmonary Tuberculosis			Rate per 100,000		
	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls
Metropolitan (Sydney)	29,846	14,995	14,851	15	10	5	50	66	34
Large Country Town	18,818	9,081	9,737	0	0	0	—	—	—
Rural	22,392	11,821	10,571	10	6	4	44	50	38

TABLE III.
Pulmonary Tuberculosis in Children.

Examined by	Schools	Pulmonary Tuberculosis					
		Definite			Probable		
		Total	Boys	Girls	Total	Boys	Girls
School Medical Officer	Metropolitan	6	5	1	2	1	1
Teacher	Metropolitan	4	4	0	3	0	3
School Medical Officer	Rural	1	0	1	5	3	2
Teacher	Rural	4	3	1	0	0	0
		15	12	3	10	4	6

These figures represent the numbers examined by the school medical officers in the schools of New South Wales. A special look out was kept for doubtful chest cases and their physical condition carefully investigated by ordinary clinical methods. In addition the head teacher was asked to state any case of tuberculosis known to him in children who had been on the roll, but who were absent at the time usually under medical attention.

In addition eight suspicious cases were met with of an indefinite but suggestive type.

TABLE IV.
Age Incidence of Pulmonary Tuberculosis.

Sex	Age Incidence (Years)										Total Number
	6	7	8	9	10	11	12	13	14	15	
Boys	2	1	3	0	4	2	2	1	1	0	16
Girls	0	1	2	0	1	2	1	0	0	2	9
Total	2	2	5	—	5	4	3	1	1	2	25

Other types of tuberculosis were noted such as tuberculosis of glands, bones, joints *et cetera.*

TABLE V.
Incidence of Other Types of Tuberculosis.

District	Number of Children		
	Total	Boys	Girls
Metropolitan	10	3	7
Large Country Town	3	2	1
Rural	12	8	4
	25	13	12

The incidence was thirty-six per hundred thousand among the boys, thirty-four per hundred thousand among the girls and thirty-five per hundred thousand among all children.

TABLE VI.
All Forms of Tuberculosis Number of Children.

District	Tuberculosis Number of Children		
	Total	Boys	Girls
Metropolitan	25	13	12
Large Country Town	3	2	1
Rural	22	14	8
	50	29	21

The incidence per hundred thousand was eighty among the boys, sixty among the girls and seventy among all children.

TYPES OF TUBERCLE BACILLI PREVAILING IN AUSTRALIA.

By W. J. Penfold, M.B., C.M., B.Hy.

The material from which the various strains of tubercle bacilli were isolated was received in the case of adults from Dr. D. G. Robertson during the time that he was making a survey of the tuberculosis of Bendigo miners. The children's material was obtained from the Melbourne Children's Hospital, very largely from the Pathological Department, for which material I must thank Dr. Webster, but twenty-three specimens which had been taken by operation were also received from the same hospital. The specimens were brought as promptly as possible to the Laboratories. In all cases careful avoidance of antiseptics was observed.

Technique.

In the case of the children's samples the original material was emulsified and inoculated subcutaneously into guinea pigs and intravenously into rabbits. Attempts were made at direct culture by the "Antiformin" method and smears of the original material were also examined in each case. In the case of the specimens (chiefly sputa) from adults, the original material was not inoculated directly into rabbits but into guineapigs only and, after the strain had been isolated from the guineapig, its type was then determined by cultural methods and inoculation in pure culture into the former species. Otherwise the material was treated as the children's material. The legitimacy of the technique adopted will be discussed in detail in the Pathological Section on Friday morning and therefore I will not deal with it further here. To you as hygienists probably only the general results of the work will appeal greatly.

Children's Material.

Seventy-two specimens were received at the Laboratories from sixty patients. The source of the material is set out in Table I. together with a résumé of the results of its examination. Twelve of the specimens did not yield cultures on animal inoculation, and it is interesting to notice that no less than nine of these were obtained from cervical glands. The other negative specimens were obtained, one from a caseous mesenteric gland, one from a calcareous nodule in the lung and one from a tumour of the inner table of the skull. It is rather curious that so many of the specimens from which tubercle bacilli were not isolated were cervical glands and should have been obtained by operation. In the case of three of the negative samples from these glands acid-fast bacilli were to be seen in the smears examined under the microscope. In the case of none of the cervical glands, from which tubercle bacilli were not obtained on animal inoculation, was it possible to cultivate an acid-fast bacillus on Dorset's egg medium. Either the acid-fast bacilli, that were seen, were dead—although this seems unlikely in view of the fact that the patients were being submitted to operation,—or there were other acid-fast organisms present which would not infect guinea pigs and would not grow at 37° C. on Dorset's egg medium.

Knowing that Johne's disease in cattle existed in Victoria, an effort was made to cultivate from these cases

TABLE I.

Melbourne Children's Hospital Material.

The Type of Tubercle Bacillus found correlated with Source of Material.

Se enty-two specimens from sixty patients.

Findings	Glands				Organs, Tissues, Fluids, *et cetera*										Totals
	Hilus of Lung		Mesenteric and Portal	Other Glands	Lung	Pleura	Sputum	Spleen	Liver	Urine	Cerebro-spinal Fluid	Skull	Vertebrae	Joints	
	Cervical	Bronchial													
Total	12	11	11	2	13	1	1	9	1	1	5	1	1	3	72
No Tubercle Bacilli	9	—	1	—	1	—	—	—	—	—	—	1	—	—	12
Tubercle Bacilli	1B 2H	2B 9H	6B 4H	2H	2B 10H	1H	1H	9H	1H	1H	1B 4H	—	1H	3H	12B 48H

Source	Glands				Organs, Tissues, Fluids, *et cetera*										Totals
	Cervical	Bronchial	Portal	Other Glands	Lung	Pleura	Sputum	Spleen	Liver	Urine	Cerebro-spinal Fluid	Skull	Vertebrae	Joints	
Operation	12	—	1	—	—	1	—	—	-	—	4	1		3	23
Autopsy	—	11	10	2	13	—	—	9	1	—	1	—	-	—	47
Discharge	—	—	—	—	—	—	1	—	—	1	—	—	—	—	2

B—Bovine type. H—Human type.

on Twort's egg medium. This was unsuccessful. Anaerobic cultivation on Dorset's egg medium was also attempted with negative results. No cultivations were carried out at room temperature and it is not yet practicable to exclude the possibility of the acid-fast organisms being saprophytes that had got into the glands from the mouth or tonsils. These twelve negative specimens all came from different cases.

Of the sixty positive specimens examined twelve showed bovine infection and forty-eight human. The totals show that the majority of mesenteric and portal glands were infected with bovine organisms, while the great majority of hilus and bronchial glands were infected with the human type, though in both the hilus glands and in the lung bovine organisms were found on two occasions. The spleen on each of nine occasions showed infection only with the human tubercle bacillus. The cerebro-spinal fluid yielded positive cultural results on five occasions and on four occasions the human organism was recovered. Three patients with tuberculous disease of the hip were found to have human infections. No case of mixed infection was found in the material.

Age Distribution of the Bovine infections.

Table II. shows the age distribution of the human and bovine infections. The frequency of each type at each age period is indicated as far as the small amount of material that has been examined, permits. The chief fact to be learned from this table is that no less than 26% of the infections of the first four years of life are bovine in origin and though the numbers are small they clearly demonstrate that bovine tuberculosis is a very definite menace to Melbourne children.

TABLE III.

SUMMARY OF RESULTS OF EXAMINATION OF MATERIAL FROM 157 CASES OF SUSPECTED TUBERCULOSIS OCCURRING IN BENDIGO.

Nature of Material:
(a) 155 sputa.
(b) 2 samples of pus one from cervical gland.
„ „ „ knee joint.

Positive Results from undermentioned "Tests."
Figures indicate number of cases.

Nature of Test	Smear	Culture	Guinea Pig Inoculation
	36	36	36
	21	—	21
	—	4	4
	—	—	8
	—	0	1
Total of positive cases by various tests	57	40	70 i.e. 44.6% of total cases
% of positive assuming the guinea pig test to be entirely reliable	81%	57%	100%

The negative sign — indicates that the test was done and gave negative results. The sign 0 indicates that the test was not done.

TABLE II.

MELBOURNE CHILDREN'S HOSPITAL MATERIAL.

Ages of Patients from whom Material was Taken, Arranged in Groups of Bovine and Human Infections.

Types of Bacilli	Age Periods (Years)														All Ages
	Unknown	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	
Bovine	1	1	1	4	2	0	0	0	0	0	0	0	0	0	0	9
Human	0	7	5	8	2	2	2	3	0	2	2	2	0	2	2	39

Results in Adults.

The seventy patients represented 44.6% of the total number examined. Of the seventy strains isolated every one was "human" in character of growth on laboratory media and also in respect of virulence for rabbits. Eleven specimens of sputum the injection of which into guinea pigs had not resulted in a tuberculous infection, had yielded in smear preparations acid-fast rods similar to *Bacillus tuberculosis*. In some instances these acid-fast rods were seen in second samples. Second samples were obtained from nine persons whose sputum when injected into guinea pigs had not produced a tuberculous infection. These samples were again injected into guinea pigs, but failed to produce an infection.

Table III. gives a summary of the results of the examination of Dr. D. G. Robertson's material from Bendigo. Seventy of the samples showed tuberculous infection on guinea pig inoculation. All except nine of these seventy samples also yielded evidence of their tuberculous nature by some other test. In thirty-six of them both the direct smear and cultivation on egg medium, after "Antiformin" treatment, gave positive results. In twenty-one instances tubercle bacilli were not grown in culture, but the smear revealed them. It must be admitted that the percentage of positive cultural results was relatively small compared with those of some of the series that have been described in the literature, but this was probably inherent in the material which was submitted for examination, evidently much of it being only slightly infected.

The cultural test only yielded evidence of infection four times when the direct smear gave negative results. Every one of the seventy strains was isolated and was found to be human in character as determined by the virulence test in rabbits and by growth on glycerine egg medium. Eleven sputa showed acid-fast rods in the smears, although these

same sputa did not infect guinea pigs, so that here again there is a repetition of what was found in the cervical glands, acid-fast rods which were not living tubercle bacilli, if virulence for the guinea pig be taken as an essential criterion. Some of these eleven sputa came from patients from whom second samples were obtained, and in some of these second samples acid-fast rods were seen again. In no case was it possible to cultivate acid-fast rods from the material which could not infect the guinea pig. Nine second samples were obtained of sputum which had on the first occasion given negative results on guinea pig inoculation and on each second occasion a negative result was obtained.

Von Pirquet Tests.

The von Pirquet tests unfortunately are only available in the case of the children. Thirty-eight of the sixty children dealt with above were examined by the von Pirquet method and five who had yielded specimens from which tubercle bacilli had not been recognized by the guinea pig inoculation test, gave positive reactions and all of these had cervical gland lesions. This suggests that the acid-fast bacilli seen in the smears of the glands may be able to produce positive von Pirquet reactions even although they are not living virulent tubercle bacilli. An alternative explanation is that tuberculous foci existed in some other part of the body in these children, but since they did not come to *post mortem* examination, it is not possible to determine this.

Nine of the children who yielded specimens infected with tubercle bacilli as evidenced by guinea pig inoculation, did not give positive von Pirquet reactions. Five of these were suffering from meningitis, and two were affected with disseminated tuberculosis with infection of the lungs, spleen, liver and gut in one case and larynx, hilus and bronchial glands, lungs, spleen, liver and abdominal glands in the second. One child with ulceration of the eyelids, erosion of the gums, ulceration of the cheek, ulceration of the bowel and peritonitis, did not yield a positive von Pirquet reaction. The ninth child was suffering from tuberculosis of the lung.

It is to be regretted that the time at which the von Pirquet test was carried out in reference to the time of death of the patients was not stated in the returns, but it is evident from the above description that the tuberculous who failed to give a positive von Pirquet reaction, were essentially those suffering from disseminated tuberculosis usually with meningitis, whereas the children without bacteriological evidence of infection who gave a positive von Pirquet reaction, were essentially those with the cervical glands which were not infective for guinea pigs, though, in some cases at least, they contained acid-fast bacilli.

My thanks are due to Dr. Webster, Dr. Boyd Graham and the members of the staff of the Children's Hospital for the very helpful spirit in which they have co-operated in this work. They have supplied me with all *post mortem* and clinical material and very full notes of the cases. It is hoped that these may be used more fully at a later date. To Miss Roberts, Officer-in-Charge of the Tuberculin Department, I owe a deep debt of gratitude for a keenness in and devotion to this work which have been beyond all praise.

THE INCIDENCE OF TUBERCULOSIS IN AUSTRALIA.

By W. J. Penfold, M.B., C.M., B.Hy.

(Continued from page 256.)

Section II.

The Results of the von Pirquet Tests in the Sick and Healthy.

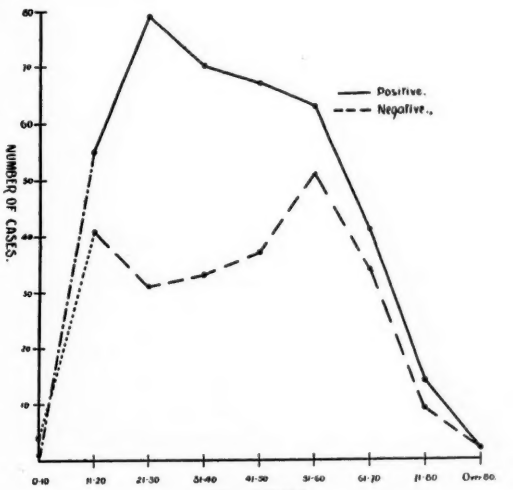
Contributions for this section were received from the medical men named in the tables.

Table I. shows the results of the examination of 1,095 hospital patients by the von Pirquet method. Of the hospital population 61% gave positive von Pirquet reactions. Of the clinically undoubtedly tuberculous 88% gave positive von Pirquet reactions. Of the patients suspected on clinical grounds of being tuberculous 68% gave positive results, while of the patients who showed no clinical signs of tuberculosis 59% gave positive results.

The results obtained in the individual hospitals are shown in Tables II., III. and IV. The average number of positive von Pirquet patients in the Melbourne and Adelaide Hospitals was 66% in each case, while in the Royal Prince Alfred Hospital in Sydney only 38% of the patients gave positive reactions.

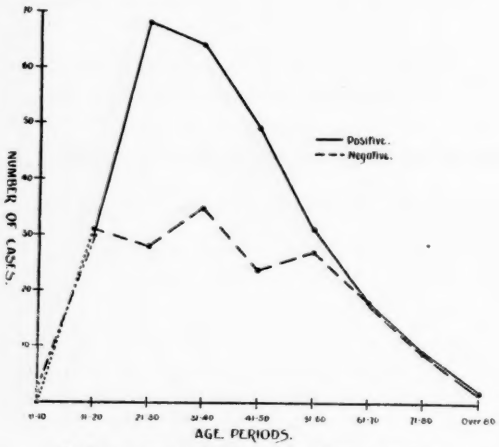
Of the undoubtedly tuberculous in the respective hospitals 91%, 75% and 100% gave positive reactions.

Of the patients showing no clinical signs of tuberculosis in both the Melbourne and Adelaide Hospitals over 60% gave positive von Pirquet reactions. Of the Royal Prince Alfred Hospital, Sydney, only 31% reacted positively. It is to be regretted that no *post mortem* returns of the Royal Prince Alfred Hospital were forwarded to corroborate this result. The number of "positive" and "negative" von Pirquet reactions obtained at the various age periods in the combined hospitals is shown on Charts I. and II.



Graph showing numbers of male cases from the Melbourne, Adelaide, & Royal Prince Alfred (Sydney) Hospitals, giving positive & negative von Pirquet reactions. Arranged in 10-yearly age periods.

Chart I.



Graph showing numbers of female cases from Melbourne, Adelaide & Royal Prince Alfred (Sydney) Hospitals giving positive & negative von Pirquet reactions. Arranged in 10 yearly age periods.

CHART II.

The combined figures from the Melbourne, Adelaide and Royal Prince Alfred Hospitals showing age and sex distribution are set out as percentages in Chart III. and Table V.

This chart shows that the age period 21-30 gives the highest number of reactions and that the position in respect of the two sexes is similar.

The only control material available showing the frequency of positive von Pirquet tests amongst normal Australian (Melbourne) adults is shown in Table VI.

From this it is seen that 70% of students between eighteen and twenty-seven years of age gave positive reactions. This figure agrees very closely with the frequency found in Melbourne Hospital patients of the same age group. No tests were done on healthy middle-aged or aged persons. Whether the diminution of positive reactors as age advances is due to the death of the tuberculous at relatively early ages or to the actual cure of the tuberculous condition, we have at present no means of discovering. Towards late life, however, a fall in the frequency of tuberculosis revealed *post mortem* has been shown to occur (see Chart I. in Section I.).

TABLE I.

VON PIRQUET REACTIONS.

Melbourne, Adelaide and Royal Prince Alfred Hospital (Sydney) Patients.[1]

Of 1095 patients 675 or 61.7% gave "positive" von Pirquet reactions.
420 or 38.3% gave "negative" von Pirquet reactions.
Of 77 patients with undoubted tuberculosis 68 or 88.3% gave "positive" von Pirquet reactions.
9 or 11.7% gave "negative" von Pirquet reactions.
Of 101 patients with suspected tuberculosis 69 or 68.3% gave "positive" von Pirquet reactions.
32 or 31.7% gave "negative" von Pirquet reactions.
Of 917 patients showing no evidence of tuberculosis 538 or 58.7% gave "positive" von Pirquet reactions.
379 or 41.3% gave "negative" von Pirquet reactions.

1. The tests were carried out under the supervision of the members of the honorary medical staff.

TABLE II.

VON PIRQUET REACTIONS.

Melbourne Hospital Patients.

Of 773 patients 514 or 66.5% gave "positive" von Pirquet reactions.
259 or 33.5% gave "negative" von Pirquet reactions.
Of 45 patients with undoubted tuberculosis 41 or 91.1% gave "positive" von Pirquet reactions.
4 or 8.9% gave "negative" von Pirquet reactions.
Of 83 patients with suspected tuberculosis 59 or 71.1% gave "positive" von Pirquet reactions.
24 or 28.9% gave "negative" von Pirquet reactions.
Of 632 patients showing no evidence of tuberculosis 403 or 63.8% gave "positive" von Pirquet reactions.
229 or 36.2% gave "negative" von Pirquet reactions
Of 13 students, nurses *et cetera* 11 or 84.6% gave "positive" von Pirquet reactions.
2 or 15.4% gave "negative" von Pirquet reactions.

TABLE III.

VON PIRQUET TESTS.

Adelaide Hospital Patients.

Of 133 patients 89 or 66.9% gave "positive" von Pirquet reactions.
44 or 33.1% gave "negative" von Pirquet reactions.
Of 20 patients with undoubted tuberculosis 15 or 75% gave "positive" von Pirquet reactions.
5 or 25% gave "negative" von Pirquet reactions.
Of 113 patients showing no evidence of tuberculosis 74 or 65.5% gave "positive" von Pirquet reactions.
39 or 34.5% gave "negative" von Pirquet reactions.

TABLE IV.

Von Pirquet Tests.

Royal Prince Alfred Hospital (Sydney) Patients.

Of 189 patients 72 or 38.1% gave "positive" von Pirquet reactions.
117 or 61.9% gave "negative" von Pirquet reactions.
12 patients or 100% with undoubted tuberculosis gave "positive" von Pirquet reactions.
Of 18 patients with suspected tuberculosis 10 or 55.6% gave "positive" von Pirquet reactions.
8 or 44.4% gave "negative" von Pirquet reactions.
Of 159 patients showing no evidence of tuberculosis 50 or 31.4% gave "positive" von Pirquet reactions.
109 or 68.6% gave "negative" von Pirquet reactions.

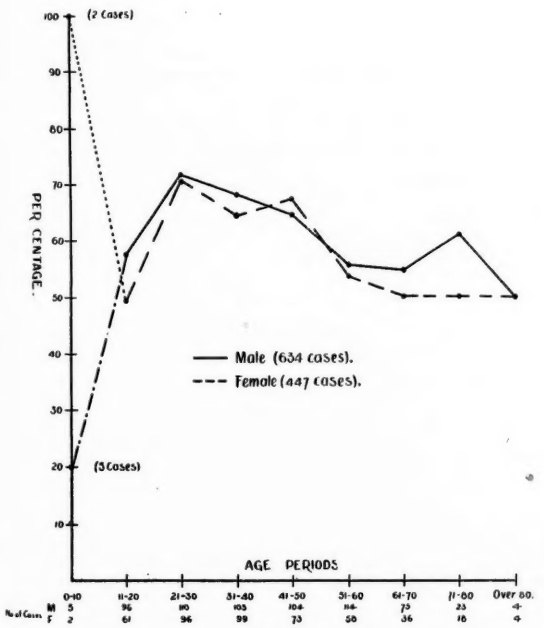
TABLE V.

Percentage of Cases showing Positive Von Pirquet Tests and Absolute Numbers of Cases showing positive Reactions.

Sex Distribution.

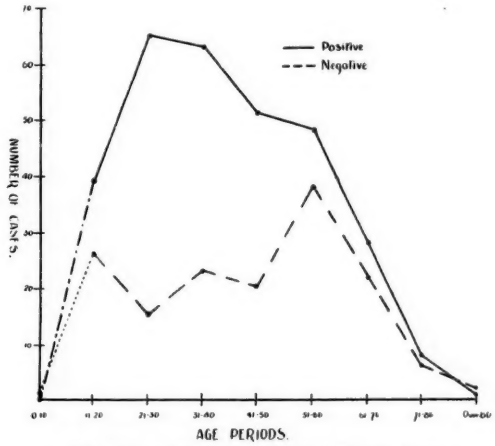
Melbourne, Adelaide and Royal Prince Alfred (Sydney) Hospital Patients.

Patients		Age Periods (Years)								
Sex	Number	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Males	634	20%	57%	72%	68%	64%	55%	55%	61%	50%
Females	447	100%	49%	71%	65%	67%	54%	50%	50%	50%
Males	634	5	93	110	103	104	114	75	23	4
Females	447	2	61	96	99	73	58	36	18	4



Graph showing percentage of male and female cases from Melbourne, Adelaide & Royal Prince Alfred (Sydney) Hospitals giving a positive von Pirquet reaction. Arranged in 10-yearly age-periods

CHART III.



Graph showing numbers of male cases from the Melbourne Hospital giving positive & negative von Pirquet reactions. Arranged in 10-yearly age periods

CHART IV.

Charts IV. to IX. inclusive and Table VII. show the age distribution of the patients giving "positive" and "negative" von Pirquet reactions in the individual hospitals. The striking fact as between the different hospitals is that in the Adelaide and Melbourne Hospitals the "positive" von Pirquet group predominates practically throughout life, whereas in the Royal Prince Alfred Hospital of Sydney, in both males and females, there is a predominance of the "negative" group. It is to be regretted that the number examined in Sydney is so small

TABLE VI.

VON PIRQUET TESTS.

Second and Third Year Medical Students from Melbourne University.

Of 100 students between the ages of 18 and 27 years, 70 gave "positive" von Pirquet reactions.
30 gave "negative" von Pirquet reactions.

Of 90 male students 64 or 71.1% gave "positive" von Pirquet reactions.
26 or 28.9% gave "negative" von Pirquet reactions.

Of 10 female students 6 or 60% gave "positive" von Pirquet reactions.
4 or 40% gave "negative" von Pirquet reactions.

TABLE VII.

VON PIRQUET TESTS.

Age Distribution.

Melbourne Hospital Patients (Males).

Response to Test	Age Periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	0	39	65	63	51	48	28	8	1
No Reaction	1	26	15	23	20	38	22	6	2

Melbourne Hospital Patients (Females).

Response to Test	Age Periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	0	18	54	48	38	24	12	8	1
No Reaction	0	12	18	19	16	17	13	8	2

Adelaide Hospital Patients (Males).

Response to Test	Age Periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	1	9	5	2	10	11	6	5	1
No Reaction	2	6	1	0	6	5	7	1	1

Adelaide Hospital Patients (Females).

Response to Test	Age periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	2	9	10	4	5	2	5	0	1
No Reaction	0	5	3	3	2	0	2	0	0

Royal Prince Alfred Hospital (Sydney) Patients (Males).

Response to Test	Age Perods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	0	7	9	5	6	4	7	1	0
No Reaction	1	9	15	10	11	8	5	2	0

Royal Prince Alfred Hospital (Sydney) Patients (Females).

Response to Test	Age Periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	0	3	4	12	6	5	1	1	0
No Reaction	0	14	7	13	6	10	3	1	0

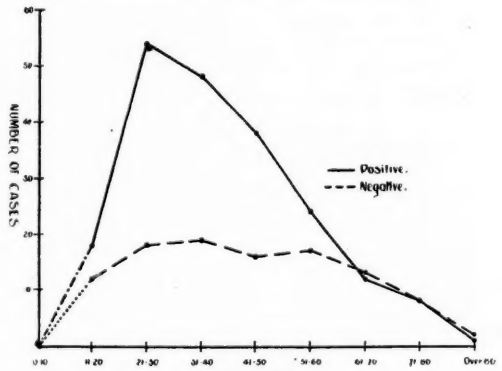
TABLE VII. (Continued.)

Melbourne, Adelaide and Royal Prince Alfred Hospital (Sydney) Patients (Males).

Response to Test	Age Periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	1	55	79	70	67	63	41	14	2
No Reaction	4	41	31	33	37	51	34	9	2

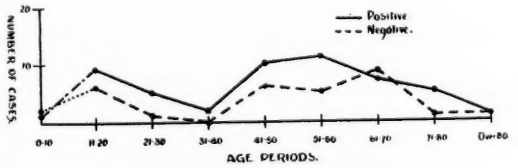
Melbourne, Adelaide and Royal Prince Alfred Hospital (Sydney), Patients (Females).

Response to Test	Age Periods (Years)								
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
Reaction	2	30	68	64	49	31	18	9	2
No Reaction	0	31	28	35	24	27	18	9	2



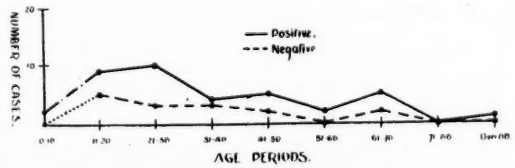
Graph showing numbers of female cases from the Melbourne Hospital giving positive & negative von Pirquet reactions. Arranged in 10-yearly age periods.

CHART V.



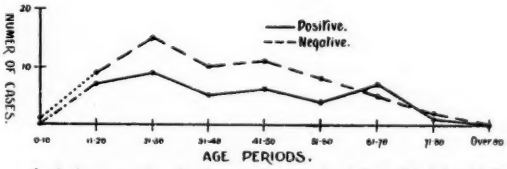
Graph showing von Pirquet reactions in Adelaide Hospital Cases — Males.

CHART VI.



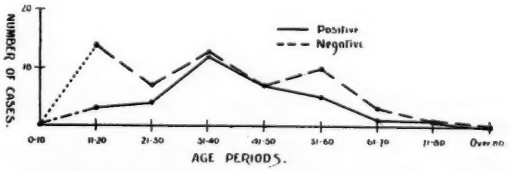
Graph showing von Pirquet reactions in Adelaide Hospital Cases — Females.

CHART VII.



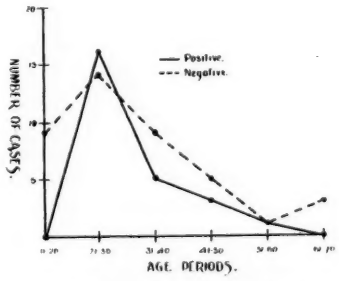
Graph showing number of male cases from the Royal Prince Alfred Hospital, Sydney, giving positive & negative von Pirquet reactions. Arranged in 10-yearly age periods.

CHART VIII.



Graph showing numbers of female cases from the Royal Prince Alfred Hospital, Sydney, giving positive & negative von Pirquet reactions. Arranged in 10-yearly age periods.

CHART IX.

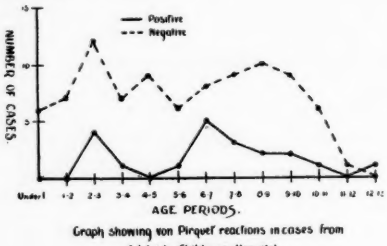


Graph showing von Pirquet reactions in Bendigo Hospital cases.

CHART X.

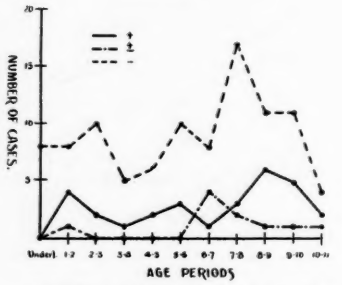
as to make it difficult to come to any conclusion with confidence.

In Chart X. and Table VIII. the results are given of the von Pirquet tests done in the Bendigo Hospital. In this case the numbers are unfortunately small, but in the middle time of life there is a preponderance of "negative" reactors. The results obtained in Bendigo approximate those of Sydney.



Graph showing von Pirquet reactions in cases from Adelaide Children's Hospital.

CHART XI.



Graph showing von Pirquet reactions in Dr. Beare's Cases.

CHART XII.

TABLE VIII.

VON PIRQUET TESTS.

Of 78 patients 27 or 34.6% gave "positive" von Pirquet reactions.

51 or 65.4% gave "negative" von Pirquet reactions.

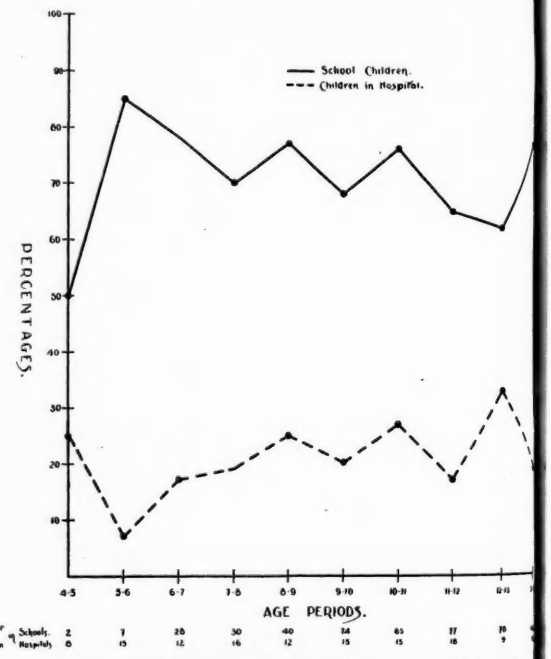
Bendigo Hospital Patients.

Response to Test	Age Periods (Years)					
	11-20	21-30	31-40	41-50	51-60	61-70
Reaction	0	16	5	3	1	0
No Reaction	9	14	9	5	1	3

The von Pirquet reactions in Children.

In Chart XI. and Table IX. the numbers of children giving "negative" and "positive" von Pirquet tests respectively in the Adelaide Children's Hospital are shown. We see that in the first year of life no patient is a "positive" reactor and throughout the whole of childhood the "negative" von Pirquet reactions greatly exceed the "positive." The number of children examined was so small as to make it impossible to give useful percentages at different age periods.

Chart XII. and Table X. show the von Pirquet reactions found in a group of children examined by Dr. Beare. He divided them into three classes: "positive," "negative" and "doubtful" reactors, and here again we see that no patient reacted "positively" under one year of age, and throughout childhood there was a large preponderance of non-reacting individuals.



Graph showing Percentages of Children in State Schools & in Children's Hospital giving Positive von Pirquet reactions.

CHART XIII.

TABLE IX.

VON PIRQUET TESTS.

Adelaide Children's Hospital Patients.

Of 110 patients 20 or 18.2% gave "positive" von Pirquet reactions.
90 or 81.8% gave "negative" von Pirquet reactions.

Response to Test	Age Periods (Years)											
	Under 1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13
Reaction	0	0	4	1	0	1	5	3	2	2	1	0	1
No Reaction	6	7	12	7	9	6	8	9	10	9	6	1	0

TABLE X.
Von Pirquet Tests.
Dr. Beare's Patients (Children).

Of 143 patients 33 or 23.1% gave "positive" von Pirquet reactions.
10 or 7% gave "doubtful" von Pirquet reactions.
100 or 69.9% gave "negative" von Pirquet reactions.

Response to Test	Age Periods (Years)											
	Under 1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13
Reaction	0	4	2	1	2	3	1	3	6	5	2	—	—
Doubtful	0	1	0	0	0	0	4	2	1	1	1	—	—
No Reaction	8	8	10	5	6	10	8	17	11	11	4	—	—

Chart XIII. and Table XI. show the percentage of patients in the Melbourne Children's Hospital giving "positive" von Pirquet reactions at different age periods. At every age period from four to thirteen years the percentage of reactors was relatively small—averaging 20.9% and never exceeding 33%. Table XI. and the upper line of Chart XIII. indicate the percentage of "positive" reactors found in healthy State school children of corresponding ages.

We have here to consider the fact that the "positive" von Pirquet reaction in actually tuberculous children is suppressed by various morbid conditions (Rolly, 1911)[1]; and it seems not improbable that other morbid conditions suppressed the positive von Pirquet reaction in the hospital children who were not clinically tuberculous.

TABLE XI.
Von Pirquet Tests.
School Children and Children in Hospital.

Age Period (years)	School Children (Healthy)			Children in Hospital		
	Number	Reaction to Test	Percentage	Number	Reaction to Test	Percentage
4-5	2	1	50	8	2	25
5-6	7	6	85	15	1	7
6-7	28	22	78	12	2	17
7-8	30	21	70	16	3	19
8-9	40	31	77	12	3	25
9-10	74	50	68	15	3	20
10-11	83	63	76	15	4	27
11-12	77	52	68	18	3	17
12-13	78	48	62	9	3	33
13-14	48	37	77	16	3	19

The tests on school children were done by Dr. Featonby.

TABLE XII.
Von Pirquet Tests.
Correlation of Clinical Diagnosis.

Clinical Diagnosis	Reaction and Test		No Reaction and Test	
	Actual Number	Percentage	Actual Number	Percentage
Tuberculous Disease of Bone	9	100%	0	0%
Thoracic	6	100%	0	0%
Generalised with Meningitis	1	25%	3	75%
Cervical adenitis	2	100%	0	0%
Abdomn'l adenitis	1	50%	1	50%
Total	19	82½%	4	17½%
Not clinically tuberculous	15	9.2%	148	90.8%
Grand Totals	34	18.3%	152	81.7%

TABLE XIII.
Von Pirquet Tests.
In Persons who spent their Childhood in Urban and Rural Districts.

Royal Prince Alfred Hospital (Sydney) Patients.

Sex	Origin	Number Tested	Reactions
Male	Urban	55	22=4 %
	Rural	44	16=36.4%
Female	Urban	44	18=40.9%
	Rural	41	14=32.6%

Adelaide Hospital Patients

Sex	Origin	Number Tested	Reactions
Male	Urban	35	23=65.7%
	Rural	46	30=65.2%
Female	Urban	35	22=62.9%
	Rural	40	28=70%

All Patients.

Sex	Origin	Number Tested	Reactions
Male	Urban	90	45=50%
	Rural	90	46=51.1%
Female	Urban	79	40=50.6%
	Rural	81	42=51.8%

1. Rolly, Munchener Medizinische Wochenschrift 1911, Numero 24.

TABLE XIV.
Von Pirquet Tests.

Austin Hospital Patients.

Of 66 patients 43 or 65.2% gave "positive" von Pirquet reactions.
5 or 7.6% gave doubtful von Pirquet reactions.
18 or 27.2% gave "negative" von Pirquet reactions.
Of 63 patients with undoubted tuberculosis 42 or 66.7% gave "positive" von Pirquet reactions.
5 or 7.9% gave doubtful von Pirquet reactions.
16 or 25.4% gave "negative" von Pirquet reactions.
Of 3 patients with suspected tuberculosis 1 or 33.3% gave a "positive" von Pirquet reaction.
2 or 66.7% gave a "negative" von Pirquet reaction.

In Table XII. the results of the von Pirquet tests carried out at the Children's Hospital (Melbourne) are given.

The "negative" von Pirquet reaction occurred apparently in only 17.5% of clinically tuberculous children. On the other hand, 9.2% of the children not clinically tuberculous gave "positive" reactions.

In children the "positive" von Pirquet apparently gives a 19:15 ratio in favour of clinical tuberculosis; while the "negative" result gives 148:4 ratio in favour of no clinical tuberculosis being present.

Table XIII. suggests that the spending of childhood in the country rather than in the city is of no advantage in endeavouring to avoid latent tuberculous infection.

Austin Hospital Results.

Table XIV. shows the relatively low frequency of the "positive" von Pirquet response in advanced tuberculous infections. It is no greater than that found in normal adults and considerably less than the frequency obtaining for the tuberculous patients found in general hospitals.

Section III.

Incidence of Tuberculosis in Bovines.

The material collected by the laboratory under this heading has been supplied entirely by Mr. H. S. Rudduck, Veterinarian, of this city (see Table I.). The tuberculin tests were carried out in each case by the subcutaneous method and in very many cases by a second method, usually Calmette's, in addition. The points of interest to us as hygienists are that 16.83% of the dairy cattle responded to the tuberculin test, whilst amongst stud cattle only 3.24% gave positive reactions. Herd No. 5 deserves special attention, for out of twenty-five head, no less than eight reactors were obtained; the owner of this par-

Table I.

Number of Herd	Number of Head	Number of Cattle reacting	Incidence of Tuberculous Cattle in Dairy Herds Examined	Nature of Herd	Approximate Distance from Melbourne	Place of Supply	Remarks
1	30	0		Stud	28	Creamery	Jersey
2	36	0		Stud	18	Creamery	Jersey
3	45	0		Stud	120	Creamery	Jersey
4	23	1		Stud	40	Creamery	Red Poll
5	25	8	32%	Dairy	10	To city infants as bottled milk	Two died from other causes, but were found to have generalized tuberculosis
6	30	0		Stud	40	Calves	Hereford
7	21	7		Stud	120	Calves	Shorthorn
8	45	3	6.7%	Dairy	20	City	
9	30	6	20%	Dairy	12	City	
10	36	12	33.3%	Dairy	40	City	Reacting animals slaughtered; two showed generalized tuberculosis; ten slight infections
11	43	3	7%	Dairy	30-50	Country residents	
12	52	0		Stud	30	Creamery	Guernsey
13	19	2	10.5%	Dairy	10	City	
14	50	5	10%	Dairy	18	City	
15	14	3		Mixed	100	Creamery (except for one house cow)	House cow reacted and two others. They were Jersey stud animals; *post mortem* showed generalized tuberculosis
16	22	6	27%	Dairy	7	City	
17	43	6	14%	Dairy	18	City	
18	33	14		Mixed	40		Young stock under three years only tested

Average dairy herd percentage of tuberculous cattle 17.8.
Total number of dairy cattle tested = 303.
Total number of dairy cattle reacting = 51 = 16.83%.
Total number of stud cattle tested = 247.
Total number of stud cattle reacting = 8 = 3.24%.
Total number of cattle in mixed herds tested = 47.
Total number of cattle in mixed herds reacting = 17 = 36.17%.
Total proportion of reacting animals in all herds taken together = 12.7%.

Remarks: Dairy cattle were all supplying milk for human consumption. Bottled milk for babies was supplied from one herd and in this case 32% of the cows reacted to the test.
From stud cattle no milk was supplied for human consumption.
In the case of mixed herds no milk was used for human consumption with the exception of that of one house cow, which reacted to the test.

ticular herd was specializing in the supply of bottled milk for the use of infants. It appears to have been with one exception the most seriously infected of the dairy herds examined.

A large number of the reacting animals came to slaughter and in no case was a reactor found *post mortem* to be free from tuberculosis.

How many infected animals are missed by the tuberculin test it would be difficult to say, but it must be a very small number. In one herd which had to be destroyed recently because of contagious pleuro-pneumonia, one or two animals who did not react, were found to be infected with tuberculosis, but as far as I am aware, there is nothing against this error having been due to the simultaneous infection of the animals with the two diseases. The remarkable freedom of stud animals from tuberculosis shows that such freedom can be obtained if the community is prepared to pay for it. The figures that I will bring forward dealing with the types of tubercle bacilli prevailing in Australia will show that the tuberculous cow is a real menace to young children and it behoves this Congress to take such steps as will minimize the menace.

Up to the present no compensation has been paid to the dairy farmer in Victoria who has used the tuberculin test throughout his herd and ridded it of tuberculosis as a result. If no compensation is to be available, some other method must be found of making it undesirable to supply milk for human consumption which has not been either Pasteurized or obtained from a tuberculin-tested accredited herd. If the owner of non-tuberculin tested cows is compelled to pasteurize his milk himself or to pay for having it Pasteurized by the municipality, while the dairy farmer who owns a herd free from tuberculosis is not required to Pasteurize the milk, I think a rapid improvement in our Victorian herds would result. The adoption at the choice of the dairyman of one or other of these two methods of dealing with the menace would almost certainly rid the children of bovine tuberculosis. In herds which show only a small percentage of tuberculous cattle, it would be a cheaper proposition for the owner to have his herd ridded of them rather than to be compelled efficiently to Pasteurize his milk. It must always be remembered that "Pasteurized" milk as sold in commerce is very commonly not Pasteurized and is frequently infected with virulent tubercle bacilli. Therefore this Pasteurization to be effective must be carried out by trustworthy persons under laboratory supervision. The probability is that a combination of these methods—the Pasteurization of milk from accredited herds—is the ultimate ideal at which we should aim, but as a practical alternative to that ideal the step which I have suggested might, I think, be taken in the first instance.

NOTE ON THE EXAMINATION OF THE SYDNEY SUBURBAN DAIRY MILK FOR TUBERCLE BACILLI.

By E. W. Ferguson, M.B., Ch.M.,
Principal Micro-Biologist, Department of Public Health, New South Wales.

For many years in the larger cities of other parts of the world, extensive investigations have been carried out into the presence of tubercle bacilli in the milk supply. In the majority of cases a relatively high percentage of the milk samples examined has been found to contain these bacilli and undoubtedly this factor must play an important rôle in contributing to the occurrence of tuberculosis in children in whom the bacilli responsible are of the bovine type. Furthermore, the examinations have afforded a means of control over individual dairies.

The investigations into the Sydney milk supply were undertaken in 1921 and at first it was decided to deal only with the milk supplied by the various dairies situated in the suburbs round about the city proper. Later it was hoped to investigate the milk supplied by the large distributing companies, from country dairies situated at greater distances from the city. The suburban milk constitutes approximately one-third of the total quantity of milk consumed in the metropolitan area. The chief difference between suburban and country milk lies in the fact that the country milk is Pasteurized, whereas suburban milk is sold raw. The investigations were, of course, carried out with raw milk, to which no preservatives had been added.

The preliminary experiments commenced in 1921 had to be abandoned temporarily owing to an outbreak of disease among the guinea pigs and later the occurrence of plague in Sydney prevented the resumption of the work until late in 1922, but since that date the investigation has been in progress and the present report can therefore only be regarded in the nature of a preliminary note.

The plan adopted was to obtain milk from each suburban district in turn; the number of dairies in each district was noted and instructions were issued for samples to be obtained of the bulk milk from each dairy in the district. The samples were first secured by arrangement with the sanitary inspector of the local council, but subsequently an officer from this department was deputed for the work. Owing to the limited accommodation available for laboratory animals only a small number of specimens could be handled at one time and a certain interval had to be allowed to elapse before the next batch was secured for examination.

Methods.

In the early experiments the contents of an ordinary centrifuge tube were spun at high speed and the sediment was injected into a guinea pig, which was killed after a varying interval of from six weeks to two months and the organs and glands examined. Later one hundred cubic centimetres of the milk were allowed to sediment in the ice chest over night; the deposit was then centrifuged and injected into a guinea pig.

In the last series of examinations the milk was centrifuged in large cups and spun for twenty minutes at a rate of three thousand revolutions per minute. Two guinea pigs were then injected with the sediment, each guinea pig receiving the residue from one hundred cubic centimetres of milk.

First Series.

Samples were investigated from thirty-four dairies situated in eleven municipalities. The results were, however, unsatisfactory, as all but seven of the inoculated animals died from another disease, which was then current in the animal cages. The seven that were killed after two months showed no sign of tuberculosis, nor did two

others that died three and four weeks respectively after the inoculation.

Second Series.

The investigations were recommenced in December, 1922, and samples from nine dairies situated in four municipalities were tested. In the case of one dairy which possessed one hundred and sixty-five cows two guinea pigs were inoculated with the deposits from the sample. All the guinea pigs were killed after from two to three months' interval, but no evidence of tuberculosis was found.

Third Series.

In the third series which were commenced in April, 1923, samples were tested from thirty dairies which were situated in six municipalities or shires. In this series the plan of allowing the milk to sediment before centrifuging was adopted. Out of the thirty guinea pigs which were injected with the deposits, eighteen were killed at the end of the allotted period and no evidence of tuberculosis was discovered. The remaining twelve guinea pigs died from some intercurrent disease, one at thirty-two days, seven at intervals of from twenty-one to twenty-eight days, two at eighteen days and two at eleven days after inoculation; none showed any evidence of tuberculosis.

Fourth Series.

The inoculations of the fourth series were only commenced on September 10, 1923, and at the time of writing the animals have not been killed, though eight have died from intercurrent disease without showing any evidence of tubercular infection.

In this series with the exception of five dairies from one municipality all the samples were injected into two guinea pigs by the method outlined previously. In the case of the five dairies only one guinea pig was inoculated from each sample. It is hoped that it will be possible to give the results obtained from the inoculations of the animals in this series at the Congress.

Summary of Results.

Excluding the animals which died before the full period the following results were obtained:

Series.	Number of Animals Injected.	Examined.
First	34	7
Second	10	10
Third	30	18
	74	35

Of the animals that died, ten had been injected for a sufficient length of time to show some evidence of tuberculosis had they been infected.

The thirty-five animals were each injected with a sample from a different dairy and the dairies were situated in twelve municipalities.

Comments.

The figures obtainable from the work, so far as it has at present progressed, are small and hardly sufficient to justify more than a preliminary note.

The failure, however, to find evidence of tubercle bacilli in any of the samples is at least surprising, when the findings for other towns in which similar investigations have been made are taken into consideration. Parker (1917) tabulates the results of twenty-two series of examinations of milk samples for tubercle bacilli carried out in the principal cities of Europe and the United States; tubercle bacilli were found in from 2% to 50%, the latter figure being found once only (Naples). For London Klein (1900) found that 7% of the milk samples tested contained tubercle bacilli; for Liverpool Delépine found them in 17.6% and Hope, working with a larger number of samples, found them in 5.2%. The figures quoted by Parker are from investigations carried out from 1899 to 1910. In the Annual Report of the London County Council for 1922[1] it is stated that of 2,284 samples of milk forwarded to London railway termini from places outside the country, sixty or 2.6 per cent. yielded tubercle bacilli as against 3.48% in 1921, 5.9% in 1920, 6.5% in 1919, 7.4% in 1918, 10.3% in 1917, and 8.7% in 1916.

Taking these figures into consideration the question arises as to the reason of the failure to find any evidence of tubercle bacilli in the samples from the Sydney milk. It should be emphasized that the examinations so far carried out have been only into milk supplied by suburban dairies. The question of the presence of tubercle bacilli in country milk either before or after Pasteurization has not yet been investigated.

The first point that suggests itself is in regard to the technique adopted. Undoubtedly the amounts used for the examinations in the earlier series were too small and it may have been that samples which were lightly infected, were missed. The samples were in each case from the bulk milk of the dairy and if only a single cow in the dairy were tuberculous, it might well be that any tubercle bacilli in the milk would be "swamped" in the process of bulking. On the other hand Delépine has shown that 0.0002 cubic centimetre of milk from a tuberculous udder diluted 100,000 times was capable of producing demonstrable tuberculosis in a guinea pig.

The second procedure adopted was better, but not completely satisfactory, but the procedure followed in the fourth series entails the examination of the deposit from a larger bulk than was used by Delépine whose method is otherwise followed.

Regarding the examinations as proving at least the comparative freedom of the Sydney suburban milk from tubercle bacilli, inquiry was made as to other evidence in support of this contention.

Attached to the Health Department is a staff of dairy inspectors whose duties include the routine inspection and examination of all the dairy herds in the vicinity of Sydney as well as elsewhere in New South Wales. According to the returns furnished by the Chief Dairy Inspector of the Health Department the number of registered dairymen in metropolitan and extra-metropolitan districts in 1922 was 408. This, however, includes dairies from as far afield as Liverpool, the milk from which would be sold as country and not as suburban milk. In the first place all cattle purchased by dairy owners are carefully examined in the sale yards so that no obviously diseased milch cows are added to the herds. I am furthermore indebted to Mr. Blomfield, the Chief Dairy Inspector, for the results of the inspections made of the suburban dairies during 1922. The figures are shown below.

1. Volume III., page 116.

Number of milch cows in the suburban area during 1922	9,702
Number inspected (including reinspections)	11,425
Number condemned	41
Disease classified:—	
Tuberculosis	24
Actinomycosis	6
Cancer	3
Pleuro-pneumonia	8
Total	41
Number of milch cows subjected to the tuberculin test	293
Number reacted	39[1]
Total condemnations for tuberculosis	63

Post mortem examinations were carried out on all the condemned animals to ascertain the extent of the disease and in nearly every case the evidence of tuberculosis was limited to small glandular lesions. In the exceptions the disease was fairly well distributed through the animal, though no actual records were kept.

In 1922-1923 the Suburban Dairymen's Association employed a qualified veterinary surgeon to inspect the dairy cattle within the suburban area. Five thousand cows were inspected, of which three were suspected of being tuberculous, and were submitted to the tuberculin test; only one reacted.

The results of these inspections must be regarded as gratifying and are strong confirmatory support to the results, however incomplete, of the animal experiments.

That the suburban dairy herds are in such a strong position as regards tuberculosis is undoubtedly in great measure due to the initial careful inspection of purchased cattle and to the supervision over the herds maintained by the Dairy Inspection Branch.

Postscriptum.

Since this paper was prepared, the guinea pigs injected with the deposits from the milk samples of the fourth series have been killed. Samples were tested from twenty-three dairies situated in four municipalities. In the case of eighteen samples two guinea pigs were inoculated each with the centrifuged deposit of one hundred cubic centimetres of the sample; in the remaining five only one guinea pig was inoculated in each case. Seven of the inoculated animals died before the end of the experiment, five in from fifteen to sixteen days and two under nine days; these animals were from five dairies and in the case of two of the dairies the second guinea pig survived to full time. Results are thus available from twenty dairies and in all cases except one no evidence of tubercle bacilli was found *post mortem*. In one case the inguinal glands were enlarged on both sides and the lumbar and mesenteric glands were also enlarged, one lumbar gland appearing somewhat caseous. The spleen contained whitish patches suggestive of tubercles. On section the glands showed hyperplasia and inflammation though the appearances were not definitely granulomatous and tubercle bacilli could not be found and it appears highly doubtful whether the lesions can be ascribed to tuberculosis.

1. This includes fifteen cows from herds belonging to Government institutions.

Adding the results of the fourth series to those of the other series it appears that out of a total of fifty-five samples tested when the experimental animals survived to the full term of the experiment, suspicious lesions were produced in only one animal.

BRIEF SURVEY OF THE VARIOUS INQUIRIES INTO PNEUMONOCONIOSIS AND TUBERCULOSIS AMONG AUSTRALIAN MINERS (1902-1921).

By Frank R. Kerr, D.S.O., M.B., B.S., D.P.H.,
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In order to investigate the particular nature and prevalence of pneumonoconiosis and tuberculosis among Australian metal miners and to discover ways and means whereby their extent may be limited, various Royal Commissions, committees and individuals have made exhaustive researches into the subject.

The Sewerage Works Ventilation Board in 1902 inquired into the conditions under which miners were employed in sewerage works in and around Sydney, where deep tunnels and trenches were dug out of the sandstone. Sydney sandstone being found to consist of from 81% to 94% silica, the Board investigated the effects on the men of inspiring air laden with siliceous dust. Various recommendations were brought forward with regard to the different processes of excavation.

In 1904 the Royal Commission on Ventilation and Sanitation of mines in Western Australia advocated the use of a large exhaust fan as the best means of artificial ventilation. Compressed air they looked upon as unsatisfactory, as it was expensive, was not circulated sufficiently, contained at times globules of oil and possessed an objectionable odour. The Commission was doubtful as to the value of using water to allay dust and thought that the resulting humidity of the air might have as bad an effect on the men as the dust, especially if the temperature were high. Many means of improving ventilation were suggested. With regard to the health of miners, the Commission heard of very few cases of miners' phthisis, but, as the number was increasing at Kalgoorlie, considered it important to commence preventive measures, advising exclusion of tuberculous persons from the mines. To amend the *Mines Regulation Act* of 1895, certain legislation was suggested, among which was the appointment of a mines regulation board to investigate health conditions; the standards of ventilation laid down were that 0.15% of carbon dioxide by volume should not be exceeded and that the temperature should not go above 29.4° C. (85° F.).

Dr. Summons in 1906 went thoroughly into the question of the ventilation of the Bendigo mines and the prevalence of tuberculosis in that city. He was evidently tremendously impressed with the facility afforded to the developement of the tubercle bacillus by the damage done to the lung by dust breathing, and indeed stated that "it can safely be concluded that all Bendigo miners dying of their respiratory diseases die of tuberculosis, except a few with acute pneumonia." The number of deaths among miners from tuberculosis was found to be six times as great as among adult males in Victoria generally.

In 1907 another Sewerage Works Ventilation Board was appointed in Sydney.

There followed in quick succession four separate inquiries, by two Royal Commissions in Western Australia, 1910 and 1911, by a Royal Commission in Queensland, 1911, and by Dr. Purdy in Tasmania in 1910. Dr. Cumpston in 1910 found pulmonary fibrosis very common among Western Australian miners and put it down to dust and dust alone. Tuberculosis of the lungs was present in only 1.5% of working miners and thus in his opinion was not prevalent in the mines to any great extent. However, he foresaw the danger unless immediate steps were taken to prevent the spread of the disease among the general population.

After eleven months' work the Queensland Royal Commission of 1911 confessed that it did not have enough information upon which to form a definite scientific opinion. Fibrosis was not found to be wide-spread nor was the relative frequency of tuberculosis excessive in Queensland metal mines as compared with those in other districts.

The 1911 Royal Commission in Western Australia realized the overwhelming importance of tuberculosis in contributing to the death-roll of miners, but saw that measures inaugurated among the miners alone would not be sufficient to protect them nor the general population. It recommended the exclusion of both tuberculous miners and silicotics and asked for the appointment of a board of mining experiments to ascertain the best methods of ventilation As an outcome of the work of the several commissions tuberculous miners are now excluded from Western Australian mines.

Dr. Purdy found the death rate from phthisis among miners in Tasmania to be very low—about 1.72 per 1,000.

The New South Wales Board of Trade in its report of 1918 gives us a full and comprehensive account of the ideas on the subject in the United States of America, Europe, South Africa and Australia, and in dealing with dust prevention very wisely states that this question "is essentially a problem which must be faced by managers of industrial enterprises. The necessary safeguards of the health of workers, where dust risks exist, are the compulsory use of copious supplies of water, regulation or limitation of shifts and exhaust or other ventilation of working places on scientific lines." The Board recommended the appointment of a Technical Commission of Inquiry to report on the question of dust, to examine air samples and to study the course of the disease, especially by radiographic methods. This Commission afterwards sat at Broken Hill in 1921.

In 1920 an inquiry into the prevalence of tuberculosis at Bendigo was made by Dr. D. G. Robertson who found a greater incidence there than in other parts of Victoria. The outcome of his investigations and recommendations has been the institution in Bendigo of a Commonwealth Health Laboratory, with a splendid X-ray plant and facilities for carrying out extensive investigations into the prevalence of tuberculosis, pneumonoconiosis and diphtheria.

The Technical Commission at Broken Hill in 1921 discovered that out of 3,967 examined, 193 miners showed signs of pneumonoconiosis, fifty-nine had the disease complicated with tuberculosis, while thirty-nine others were suffering from tuberculosis without any sign of previous fibrosis. Steps were recommended to exclude tuberculous and silicotic sufferers from the mines both on the surface and underground, to provide employment elsewhere for those withdrawn from the mines, to compensate the consumptives, to insist on preliminary and periodic medical examinations of all workers and to establish an investigating laboratory.

A description of the comprehensive and exhaustive inquiry pursued by the Technical Commission is given in its further reports published in 1922. It expressed the opinion that with certain precautions in mining the amount of dust present would be reduced to such an extent that pneumonoconiosis would not occur. These precautions are:

(i) That the firing of explosives takes place at the end of shift;

(ii.) That a water blast is used after firing explosives except in an open stope with an air current moving through it with a speed of twenty feet a minute or more and in a square-set stope with through ventilation;

(iii.) That an interval of thirty minutes elapses after firing explosives before work, such as shovelling ore, boring and charging holes or timbering be resumed in a working place, and

(iv.) That the boring of holes with drills is undertaken with certain precautions enumerated in full in the report.

In the removal of dust the Technical Commission looked upon ventilation of the mines as the most important factor and recommended the continuation of exact observations of temperature, humidity and cooling power of the air, along with systematic dust sampling. This has been done with great success in the Broken Hill mines.

Taking a bird's-eye view of all this work, we find first of all with regard to pneumonoconiosis that all the investigators are agreed as to the cause and mode of onset of this insidious disease. Splendid descriptions have been given in most of the reports of the gradual invasion of the delicate alveolar tissue by mineral dust, the changes set up producing chronic inflammatory formation of fibrous tissue with its ultimate contraction and obliteration of the fine air vesicles, leading symptomatically to shortness of breath on exertion. It is maintained by all that in this condition the lung is more liable to inflammatory attacks and provides a suitable medium for the subsequent developement of the tubercle bacillus. Slight differences have been noted, however, and at Broken Hill in 1921 it was found that there was much less involvement of those parts of the lung immediately concerned with respiration than was the experience at Kalgoorlie and Bendigo, resulting in less shortness of breath. By this is meant that the fibrous tissue growth was apparently confined to the course of the bronchi and bronchioles and did not invade the air cells to any extent.

At Bendigo the particular responsible agent was mainly the sharp and jagged particles of quartz dust, while sandstone was present in the Sydney sewerage diggings. The miners at Kalgoorlie, however, inhaled a dust very much softer and rounder, free from sharp edges, composed of under 50% silica and considered less dangerous by the Royal Commission of 1912.

If the inspiration of siliceous dust is the forerunner of such incalculable harm, the essential point in all investigations of this kind is to prevent dust production or at any rate to prevent dust inspiration. Elaborate schemes have been drawn up to compensate sufferers, to carry out

medical examinations at all stages of a miner's career and to exclude the diseased from working. It is often forgotten, however, that if there were no dust, there would be no fibrosis and therefore no greater amount of tuberculosis among miners than among other workers. Slight differences of opinion have arisen in the methods suggested. There seems no doubt that the use of water, in the form of an atomiser or spray, is the most reliable way to allay dust, yet we find that the Western Australian Royal Commission of 1904 was alarmed at the resulting humid atmosphere. Surely with adequate air movement throughout the mine the evils of excessive air moisture would be almost negligible. Dr. Summons considers on this point that "moisture in the air appears much the less of the two evils, for dust more quickly incapacitates a man from work, whereas men living in tropical climates which are comparable to the conditions below maintain their health for many years." The aim, therefore, of all mine ventilation is to consider dust arresting of paramount importance.

A great difference is noticed in the tuberculosis figures in different localities. For example, comparing Bendigo and Western Australia, in the former we find that fibrosis of the lungs was always, sooner or later, engrafted with tuberculosis, unless the sufferer died of an intercurrent pneumonia, while it was Dr. Cumpston's experience in the Western Australian mines to find no more consumptive miners than 1.5%. The conclusion is, therefore, that the incidence of tuberculosis depends almost entirely on local conditions. Although much tuberculosis is spread among miners underground because of their intimate contact, making it necessary to exclude all consumptives, nevertheless the greater number of cases of infection are thought to occur on the surface, in the homes of the men and in places of usual resort. If there is much of the disease among the general population the miners will be attacked to an alarming extent. It is only a question of time before the Western Australian and Queensland mines will be comparable to those of Bendigo, unless tuberculosis is obliterated throughout the country. Dr. Haldane referring to silicosis said: "I believe the disease is the same all over the world and the end comes through tubercular infection."

The question of ventilation has been thoroughly thrashed out in nearly all the inquiries and many methods, both natural and artificial, have been discussed and recommended. Contrary to the experience of the Western Australian Royal Commission of 1904, Dr. Summons considered that the use of compressed air in ventilation was very advantageous, though expensive. The maximum of 0.15% of carbon dioxide is suggested universally as a standard, and although it is realized that this means nothing in itself it is an index to the adequate entrance of the air from outside. A temperature of 30° C. (86° F.) is considered the highest desirable from the point of view of efficiency; but it was found in 1911 that many miners in Western Australia were working when the thermometer reading showed 35° C. to 37.8° C. (95° F. to 100° F.) with very considerable humidity.

The Royal Commission at Broken Hill in 1914 published a table showing the deaths from lung diseases during five years from 1909 to 1913. This table showed that there were actually more deaths from pulmonary tuberculosis among the non-miners than among those employed in the mines. The explanation probably was that many miners when hopelessly afflicted went home to South Australia and elsewhere to die and that others, although tuberculous, were carried off by some other intercurrent disease.

Compensation presents many difficulties, and, had the dust question been conquered, would not now give so much trouble. Many suggestions have been given in the different reports, but perhaps the best scheme put forward is the mining insurance trust fund suggested in Western Australia in 1911. The insurance trust fund is to receive contributions of one-third of the total premium from the Government, one-third from the mine owner and one-third from the miner.

PULMONARY TUBERCULOSIS IN ASSOCIATION WITH PNEUMONOCONIOSIS.

A Study of the Incidence of Pulmonary Tuberculosis in a Group of Specially Susceptible People.

By S. A. Smith, M.B., Ch.M. (Sydney),
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At Broken Hill the Technical Commission of Inquiry discovered that there was a high incidence of infection with pulmonary tuberculosis among mine workers who had changes in their lungs due to dust. The evidence that the lungs of these men are affected by dust was obtained by the clinical and radiographical examination of 8,966 mine workers and the *post mortem* examination of a number of their lungs both by pathological and chemical means.

Radiographically the appearances seen in the lungs of persons suffering from pneumonoconiosis are quite characteristic and they vary with the extent of the pathological changes induced by the dust. The picture differs from the normal radiogram by an increase in the hilum shadow. This is due to peribronchial thickening about the numerous bronchi which form the roots of the lungs,—the reaction to the invasion by dust, and a similar change in the hilum glands. In the next place there is a generalized nodular increase in the reticulum shadow. This change is caused by the varying projection of the shadow of the fibrosis surrounding the bronchi and the bronchioles and of the fibrosis of small areas whose blood and lymph supply have been cut off by pressure of the increasing peribronchiolar fibrosis.

It is the characteristic generalized nodular or granular appearance which differentiates the condition from others giving similar radiographical appearances.

Characteristic clinical signs and symptoms were found only when the radiographical appearances were well-developed, especially when the pneumonoconiosis had developed as a result of work in Broken Hill mines only. The classical picture of a late stage is that of a miner who complains that of late he blows after unusual exertion, has to stop occasionally on ladders, has a regular morning cough, gets more frequent colds which last longer, and who on examination shows poor or altered expansion, has areas of weak breath sounds and definite distress after exertion.

Post mortem examination of the lungs of a number of these miners has given a means of checking the pathological with the X-ray and clinical picture.

Radiography has played the greatest part in diagnosis and the standards used have been laid down after comparison of the results of this form of examination of the first two or three thousand mine workers, with those obtained by investigators in other parts of the world, notably in South Africa.

An increased incidence of pulmonary tuberculosis was found amongst these men. The increase in susceptibility can be measured by a comparison of the amount of tuberculous infection among those mine workers who were "dusted" and among those who showed no signs due to dust.

The uninfected groups were drawn from similar industrial groups, that is who had done similar work for similar periods and were exposed to identically similar risks of a tuberculous infection.

The following table contains the information collected.

TABLE I.

TABLE OF COMPARISONS.

(i.) Total number of workers completely examined 8,966.
(ii.) Number of workers showing changes due to dust 322.
(iii.) Number of above (ii.) suffering from tuberculosis 148 or 46%.
(iv.) Number of workers showing no changes due to dust 8,644.
(v.) Number of above (iv.) suffering from tuberculosis 161 or 2%.

The inference from the table is that "dusted" persons are twenty-three times more susceptible to pulmonary tuberculosis than "non-dusted" persons.

Among the three hundred and twenty-two men affected with pneumonoconiosis one hundred and seventy-seven suffered from simple fibrosis (*id est* they were not affected with tuberculosis at the time of their first examination).

The subsequent history of these men showing the evidences of changes in their lungs due to dust alone have been followed for a period of over two and a half years and it has been possible to measure in some degree the risk of infection in different conditions of exposure.

The distribution of the susceptible persons is shown in Table II.

TABLE II.

DISTRIBUTION OF SUSCEPTIBLE PERSONS.

Place.	Number of Persons.	
	Total number.	Number with pulmonary tuberculosis.
Broken Hill	101	27
Adelaide	19	7
Melbourne	6	0
Sydney	2	0
Ballarat and Bendigo	3	1
Newcastle	1	1
Griffith	34	1
River and Country	11	0
Cities	132	36 = 27%
Country	45	1 = 2%

The table shows the location of these men and gives the number who have developed signs and symptoms of pulmonary tuberculosis in each place.

From the facts set forth conclusions may be drawn as to the effect of a special susceptibility, one which may be accurately described as acquired, in the production of the increased incidence of pulmonary tuberculosis. In the men under consideration no influence other than the lung changes induced by dust could be shown to account for the great incidence of phthisis. The absence of any past history and of any family history of tuberculosis in a great majority of these men indicates that they were not more liable to tuberculosis than those in the control group who had not contracted fibrosis by middle life. A search for other possible factors present before the onset of the changes in the lung due to dust was unproductive. It is clear, therefore, that the greatly increased liability to tuberculosis in these men, namely that they were twenty-three times more susceptible than the control group, is a direct result of the organic changes in their lungs due to the inhalation of dust.

These facts are of interest also in the general problem of phthisiogenesis. Two explanations may be considered to account for the increased incidence of phthisis in men whose lungs have been "dusted." The first is that it is due to the increased frequency with which previously inactive foci become active. The second is that it is due to the increased vulnerability (acquired susceptibility) by reason of which subsequent infection is more likely to occur. In other words was the seed sown before or after the soil was altered? Study of the development of diagnosable tuberculosis in those persons kept under observation since their withdrawal from the mines at Broken Hill presents data for discussion in relation to these two possibilities. Among one hundred and thirty-two men who have continued to live in towns or the neighbourhood of cities, thirty-six or 27% have become tuberculous. Among forty-five men who have lived away from densely populated areas, one man or 2% have become tuberculous. The outstanding difference between these two groups is the different densities of population of the areas in which they are living and the consequent difference in the risk due to the number of contacts.

If this increased incidence of tuberculosis is due to activation of previously existing foci in the lungs, it is difficult to understand why this has occurred in so few instances among dwellers in the country, while occurring in such a relatively greater number (thirteen times as many) in town dwellers. If, on the other hand, tuberculosis in these men has resulted from an infection subsequent to the occurrence of the changes due to dust, the freedom of the country dweller is easily explained by the diminished risk of infection resulting from the infrequent contact with individuals affected with tuberculosis. It is clear that the patient living in the town comes into contact each day with a much greater number of persons than the patient living, for example, in an irrigation colony on the Murrumbidgee.

Some may, however, suggest that the increased incidence in town dwellers is not due to more frequent doses of tubercle bacilli consequent upon more numerous contact with infected persons, but that the lessened incidence in country dwellers is due to their improved mode of life. While it may be difficult to define concisely what constitutes fresh air, "open" air, good food and good hygienic conditions, there is a wide-spread belief that these condi-

tions are obtained in country life and that combined with abundant sleep moderate exercise and the avoidance of late hours they improve the functions of the body. Many would infer that these conditions increase the resistance to infective diseases, raising in some manner the natural immunity of the body.

It does not appear to us that these conditions are sufficient to account for the low percentage of infected persons among those living the country life. It may further be pointed out that the town dwellers include one hundred and one persons residing in Broken Hill. Broken Hill is a country town situated on a plateau three hundred metres (one thousand feet) high in an area of low humidity. Its climate is of such character that many persons affected with pulmonary tuberculosis have proceeded to Broken Hill and have lived there for the benefit of their health. It possesses, however, a population of 27,000 people living in a comparatively small area and therefore, affording abundant chances for the transference of tubercle bacilli.

Of the one hundred and one persons suffering from pneumonoconiosis who remained in Broken Hill, twenty-seven or 27% have developed pulmonary tuberculosis.

We conclude, therefore, that changes in the lungs due to the inhalation of certain mine dust produce a definite susceptibility to the developement of pulmonary tuberculosis; that the developement is most frequently not an activation of an old lesion but a new infection and that the frequency of infection is proportional to the number of persons with whom the affected worker is daily brought in contact.

TUBERCULOSIS IN NATIVES OF THE TERRITORY OF NEW GUINEA.

By G. M. Heydon, M.B., Ch.M., D.P.H., D.T.M. and H.
From the Laboratory of the Commonwealth Department of Health, Rabaul.

Autopsies.

Of ninety-eight autopsies on natives performed by the writer during the last two years, death was due to tuberculosis in twenty-two, about 22%.

In seven others, dying from other causes, tuberculous lesions were found, so that the total percentage showing tuberculous infection was about thirty.

Most of these natives were work boys in the Rabaul district, drawn from various parts of the Territory, but a few were local free natives. The majority were males, only one was below twelve years of age and the average age was perhaps about eighteen years. Many of the cases were examples of very acute and rapidly spreading disease, with great tendency to generalization. These natives show the low power of resistance to the disease characteristic of many native races.

It will be noticed that in the majority of patients showing any tuberculous infection, this had caused death; only seven of the natives dying from other causes had tuberculous lesions. In three of these seven the bronchial glands only were affected, in one the abdominal glands only, in one both bronchial glands and mesenteric glands, and two showed lesions in the right apex (in one without caseous foci in the glands).

Of the total twenty-nine natives ten only showed in any of the lesions apart from lymphatic glands any old cicatricial tissue whatever, giving evidence of partial or local arrest at some stage: in a few, however, the amount of fibrosis was considerable.

The twenty-nine cases may be classified as follows:—In five cases the lymphatic glands were alone affected. These were all in persons who died from causes other than tuberculosis, and have been referred to above.

Four were cases of tuberculous meningitis. Three were in adult males and one in a female of about four years of age. In two of the adults the only tuberculous lesions outside the central nervous system were in the bronchial glands. In the other the right lung and pleura and a right bronchial gland were affected, in addition to the meningitis, which involved the cord to an unusual extent and had given rise to an *ante mortem* diagnosis of transverse lesion of the cord. This was the only case resembling fibroid phthisis seen and also the only one with evidence of hæmoptysis. In the fourth case, that of the child, in addition to the meningitis one bronchial gland and some of the mesenteric glands showed caseous foci.

Six were cases of pulmonary tuberculosis, confined to the lungs or to the lungs and tracheo-bronchial glands; one native had also secondary tuberculous ulcers of the ileum with caseation of the glands draining them.

Fourteen were cases of generalized tuberculosis. In all of these the lungs showed tuberculous lesions of some kind. Several were cases of acute generalized miliary tuberculosis showing no other type of lesions, outside the lymphatic glands.

The sites of the lesions which had the oldest appearance were noted in twenty-five: these were the lungs in nine, the tracheo-bronchial glands in five, the lungs or bronchial glands in five, the cervical or upper mediastinal glands in two and the mesenteric glands in four. It is, of course, not claimed that these observations necessarily indicate the routes of infection.

Of the total twenty-nine persons twenty-one showed pulmonary lesions of some kind. In thirteen of these in which notes were kept of the condition of the tracheo-bronchial glands, caseous deposits were present in one or more glands in eleven and absent in two.

The similarity between tuberculosis in native races and in white children has often been pointed out and is shown by these natives in the tendency to miliary tuberculosis, broncho-pneumonia and tuberculous meningitis. No case of tuberculosis of the bones or joints was seen.

Of eight Chinese, excluding babies, who were seen *post mortem*, three had died of tuberculosis and five showed tuberculous lesions. There was evidence of more power of resistance to the disease than the natives. Their average age was much above that of the latter.

Von Pirquet Tests.

Altogether 1,679 adult natives (estimated to be over fifteen years of age) were tested and 353 children (estimated to be under fifteen).

A reaction to the von Pirquet test was obtained in 520 out of the 1,679 adults or 29.9% and in forty-eight out of the 353 children or 13.6%.

Two groups of which these natives were mainly composed, may be considered separately, namely indentured labour in the Rabaul neighbourhood and free villagers. The former were drawn from various parts of the Territory and the majority were labourers on plantations near

Kokopo or Rabaul. Most of the adults had worked near settlements for two years or longer.

The figures for this group are given in Table I.

TABLE I.

Age	Sex	Number Tested	Number Reacting	Percentage Reacting
Adult	Males	902	307	34
Adult	Females	59	25	42
Adult	Both	961	332	34.5
11 to 14 years	Both	133	24	18

The other group consisted of free local natives from villages close to Rabaul and the figures for these are given in Table II.

TABLE II.

Age	Sex	Number Tested	Number Reacting	Percentage Reacting
Adult	Males	248	73	29.4
Adult	Females	262	60	23.3
Adult	Both	510	133	26
11-14 years	Both	79	6	7.6
1-10 years	Both	85	6	7
Under 15 yrs	Both	164	12	7.3

The most noteworthy difference between this group and that of the plantation hands is the lower rates in women and in the age group 11 to 14 years. In the villages the women and children lead a more secluded life than on plantations, but this is not true to the same degree of the men in villages close to Rabaul.

Three small lots of newly recruited boys who had left their native villages in different parts of the Territory for the first time about two months previously, were tested and all showed low rates. Of the total one hundred and sixteen tested, eight reacted, a rate of 6.9%.

A larger series of newly recruited boys from districts remote from any settlement, or of villagers in such districts would have been of interest. These I have not yet been able to get.

Von Pirquet reaction rates are of value as a measure of the extent to which tuberculous infections have occurred in a population; they do not measure their results. These, the amount of active and progressive disease which exists, depend on factors which are far from being completely understood and as to which different views are held. For instance, it remains undecided how far the susceptibility to tuberculosis shown by many native races is an inborn character, alterable only in the course of many generations by selection, or is due to different conditions of exposure to infection from those prevailing in a white race.

It is clear, however, that in a race which, from whatever causes, is highly susceptible to tuberculosis, a low von Pirquet reaction rate, judged by the standard of white communities, may be of serious significance. The type of disease found at autopsy shows that the susceptibility in these natives is high and it may be presumed that the von Pirquet reaction rate found about 30% in adults and 14% in children in the Rabaul neighbourhood means a considerable amount of active disease. Clinical evidence, as far as it exists, is to the same effect.

The ways in which tuberculosis is being spread in the Territory and the rate at which the spread is occurring are the questions of practical interest.

The pulmonary route is probably the important one. The tropics are very unfavourable to the persistence of the tubercle bacillus in the open or in the very open and airy bungalows which are a necessity to the white man. The native, however, prefers the most confined and stuffy quarters. Village huts are dark and cramped. The indentured boy loves to foregather by day or night with the largest possible number of his friends in the smallest possible room. At settlements boys speaking the same language sleep crowded together whenever they can, with a preference for total absence of ventilation. These habits naturally favour the spread of the disease. So does spitting, especially profuse when betel is being chewed in a sociable gathering. The villages, in proportion to their remoteness and the extent to which recruits are drawn from them, are continually receiving boys returning from settlements on the expiry of their contracts.

The Chinese are probably of more importance than the whites as the original source of tuberculosis in the natives. In many of the settlements they are more numerous than the whites, suffer from active pulmonary tuberculosis to a far greater extent and come more closely into contact with the natives.

The bovine bacillus, as in most tropical countries, is probably rare. A few cattle and goats exist at settlements and on some plantations.

The only domestic mammal which occurs throughout the Territory is the native pig, much crossed with European breeds in the more settled districts. They are often eaten by the natives incompletely cooked. In a series of several hundred slaughtered pigs examined in Rabaul, glandular tuberculosis was found in a considerable minority by the Sanitary Inspector of the Public Health Department of the Territory and was investigated in this laboratory. Many of the pigs had been fattened by Chinese. The lesions were stationary or retrogressive in most cases and were sometimes confined to the glands of the submaxillary region.

The type of bacillus in these pigs, probably human, has not yet been determined.

With reference to the rate of the spread of tuberculosis in the native population, some figures in a German report by Dr. Kopp dated July, 1914, are of interest. This has only been available to me in translation in the *Government Gazette*, Rabaul, January 15, 1915. The report gives the results of tuberculin tests on natives, carried out shortly before by an injection method. Details of the technique are not given. Three villages near Rabaul, namely Matupi Island, Nodup and Raluana, gave the results which are given below together with those recently given by the von Pirquet test in the same three villages (see Table III.).

TABLE III.

Age	Sex	Year	Number Tested	Number Reacting	Percentage Reacting
Adult	Males	1914	145	15	10.3
Adult	Males	1923	188	62	33
Adult	Females	1914	116	10	8.6
Adult	Females	1923	222	56	25.2
Children	Both	1913	182	10	5.5
Children under 15	Both	1923	155	12	7.7

These figures would seem to show a progress of the infection during the last nine years.

Conclusion.

The facts given in this paper show that tuberculous infection is moderately prevalent in natives of the Rabaul district, especially in indentured labourers. Nevertheless, on account of their great susceptibility, it is a very important cause of death among them, second only to pneumococcal infections and the number with active disease must be considerable.

The same is probably true of other settled districts.

Tuberculosis is spreading throughout the native population generally and as settlement increases and native labour is made use of to an increasing extent, its rate of spread will tend to increase.

Favourable factors are the dispersed character of the small native villages in the thinly populated country and the absence at present of large aggregations of natives at extensive works.

Alcoholism, by which it is often sought to explain the lack of resistance to tuberculosis of native races, plays no part in the Mandated Territory of New Guinea.

DISPENSARIES AND THEIR VALUE IN THE CONTROL OF TUBERCULOSIS.

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Before this assembly there is little need to emphasize the value of anti-tuberculosis dispensaries in the control of tuberculosis. We are all agreed that dispensaries are necessary, though we may differ as to the scope of their work. The dispensary should form the centre round which all other methods of treatment are grouped. In this paper it is proposed to place before you a few of the results of ten years' experience in the work of the Anti-Tuberculosis Dispensary at the Royal Prince Alfred Hospital, Sydney.

Briefly the objects of the dispensary are to determine the presence or absence of tuberculosis in the patient, to decide its extent, to ascertain whether the process is open or closed, active or quiescent, to gain information as to the patient's mode of life, temperament, environment and financial position, to determine the best mode of treatment for the individual, whether to treat him at home, or send him away, and lastly to educate and drill him in the precautions necessary to render him innocuous to others. If he go away either to a sanatorium or to a home in the country, the dispensary should keep in touch with him and regulate his life on return. To carry out this duty efficiently, close cooperation should exist between the dispensary and the sanatorium.

The dispensary should inspect through the medium of the tuberculosis nurse, the home and surroundings of the patient so as to remove sources of infection and predisposing causes of disease in other members of the home. The physician should examine and where necessary reexamine contacts and so detect early, latent or unsuspected cases. And lastly the dispensary should educate the public through patients and contacts.

The dispensary should always be attached to a general hospital and should not attempt to work as a separate institution. The reasons for this are obvious. The general hospital provides facilities for radiographic examination, for testing sputum, for examining the larynx and sinuses, for the preparation of vaccines, for treatment by pneumothorax or other special methods, for admission of the patient to hospital for special tests, for transfer of patients to the dispensary from the hospital and for the investigation and subsequent care of all patients with pleurisy, hæmoptysis or active tuberculosis. The hospital is also enabled to give the dispensary the aid of the existing social service department.

Lastly an important advantage of the dispensary's attachment to a general hospital is the fact that patients can attend without being branded as tuberculous.

A dispensary should be attached to every large general hospital and serve a specified district so as to prevent overlapping and to insure the interception of all cases. All patients entering hospital and suspected of tuberculous infection should be sent to it on leaving. All patients discharged from sanatoria should be instructed to attend the dispensary of their respective districts and the dispensary should be notified by the sanatorium of the discharge of the patient. Every patient with suspicious or definite signs of tuberculosis who is unable to pay for private treatment, should be sent for care to the dispensary. In this way all patients would be kept under supervision and prevented from relapsing. At the same time a general control would be exercised over the indigent tuberculous patients throughout the State.

As the result of the deliberations of the Tuberculosis Advisory Board appointed in 1912 to advise the Premier and Chief Secretary of New South Wales, it was recommended that anti-tuberculosis dispensaries be opened in connexion with the Sydney and the Royal Prince Alfred Hospitals. Royal Prince Alfred Hospital fell in with the idea and a dispensary has existed there for ten years past. It comprises one full and two assistant honorary physicians, a resident physician and two full time nurses. All patients with tuberculosis or suspected tuberculosis attending the hospital are referred to it and the practitioners in the surrounding districts are supplied with admission cards stating the hours of attendance and the mode of sending patients to the dispensary.

On their first attendance patients are seen by the resident physician and nurse, their histories are taken, a von Pirquet test carried out, the sputum taken for examination and an X-ray examination made of their chests. Subsequently they attend on Wednesday afternoon or Tuesday evening when their cases are dealt with by the honorary physician in attendance. Where necessary the patient is taught to keep an hourly record of his temperature.

During its ten years' existence the dispensary has dealt with an average number of patients including contacts in attendance of 536 *per annum*. The average number of attendances *per annum* has been 2,700.

Many of the figures for three or four years are incomplete, but for every hundred patients in attendance one hundred and seven contacts were examined. This latter figure is apparently low, but it should be remembered that many patients sent for examination were found to be non-tuberculous and no "contacts" were required to attend. In other cases great difficulty was experienced in coaxing contacts along.

About three hundred sputum tests and four hundred and fifty radiographic examinations are performed each year. In 1922 the two nurses paid 1,561 visits to patients' homes and in 1923 (the hospital year ends in June) the number of visits totalled 1,205. In 1922 eighty patients were dispatched to sanatoria and sixty-four to the country. In 1923 the respective figures were seventy-seven and seventy-two. In many cases financial assistance in the form of State aid and invalid pensions is procured for patients. In the last four years an average of fifty-five patients were thus assisted. In addition we have at our disposal small private funds out of which we are able to supply milk, eggs, bedding and clothing to the destitute. In the case of tuberculous soldiers the Red Cross Society has been particularly generous in this regard.

The use of tuberculins at the dispensary has undergone a great variation. When the clinic first opened, almost every tuberculous patient was treated with tuberculin injections. Up to 1917 the number of patients reporting weekly for this therapy was very large. Thence on, however, the use of tuberculin rapidly declined, until this year only six patients have undergone this form of treatment. As our methods and the inquiry by the nurses into the home conditions of the patients advanced, we preferred to rely more on hygienic measures, on dispatching patients to sanatoria, country homes and less crowded suburbs, on bettering their food and sleeping conditions, rather than to concentrate on tuberculin therapy. While certain of our patients have thrived on tuberculin, we have not been persuaded that this form of treatment is specific. The implicit faith of many patients in the virtue of a series of subcutaneous injections has certainly improved their health, but with the decline of the use of this remedy and concentration on the betterment of the home and its surroundings, we have obtained, if no better, certainly no worse, results

In regard to the von Pirquet test, 57% of contacts gave a positive reaction. The percentages of positive reactions at various ages were as follows:

0 to 4 years	45%	(78	contacts counted).
5 to 9 years	52%	(171	„ „).
10 to 19 years	60%	(213	„ „).
20 to 29 years	65%	(109	„ „).
30 to 39 years	56%	(100	„ „).
40 to 49 years	59%	(52	„ „).
50 to 59 years	65%	(23	„ „).

The percentage of contacts infected with tuberculosis was 28.3%.

Experience at the Royal Prince Alfred Hospital for ten years has brought out the following points.

(1) The importance of securing the right type of resident medical officer and nurse. The whole success of the dispensary depends on the keenness, tact and skill of these officers, more particularly that of the nurse. The right type is not easily found. It is not merely a matter of academic skill. The power to gain the confidence and good will of the patient is essential, as are infinite patience and the expenditure of much time in obtaining a correct and detailed history, in educating the patient and in convincing him of the wisdom of the course mapped out for him. Treatment consists mainly in rearranging his life on fresh lines and involves knowledge of his temperament, failings, needs, finances and all the other details that make up the life of himself and his family. These data are collected by the resident medical officer and nurse and demand a temperament not commonly found.

(2) The next important point after securing the right staff is to see that they remain. At the Royal Prince Alfred Hospital we are fortunate in being able to keep our nurses for long periods, but the members of the resident staff change so frequently that they are only beginning to know their duties and their patients by the time they are leaving. Appointments for resident physicians should be for at least one year and preferably longer. For nurses the posts should be permanent. In this connexion it is well to make the nurse's appointment a probationary one at first, as once she is appointed it is difficult to dismiss her if she is unsuitable.

(3) Another point that has forced itself strongly on us is the need for a fund to offer immediate help to indigent patients to get them such extras as blankets, blinds, sputum flasks, thermometers, food dainties *et cetera,* when circumstances compel them to remain in their homes. Many of these things can be got through various organizations, but demand much sacrifice of time on the part of the nurse and patients' relatives and often delay in procuring them. We have been fortunate at the Royal Prince Alfred Hospital in obtaining such help from time to time from private sources and so the nurse has been able to procure necessaries at once.

An urgent need and one which it would well pay the State to provide is the means to send the family and near contacts of a patient on holiday and so nip commencing trouble in the bud. Quite frequently the contacts of an "open case" are found to consist of a debilitated wife and weedy children who yield a von Pirquet reaction and exhibit a temperature varying from 37° C. to 38° C. Though they show no physical signs or other evidence of affection, we are satisfied that these contacts are infected and that a month's holiday in suitable surroundings would make all the difference between arrest or subsequent affection. This slight rise of temperature in contacts we consider of the greatest importance and it is one of the earliest symptoms of affection. Contrary to the views expressed by speakers at the Brisbane Congress we hold that the heat regulating mechanism in the human body is extremely reliable and that in the healthy individual the upper limit 36.9° C. is very constant. Any rise above that point requires explanation and in the absence, after diligent search, of any discoverable cause points strongly to tuberculous infection. This conclusion is only warranted after every other possible cause of derangement of the heat regulating mechanism has been excluded.

In making a diagnosis we have relied on the combined evidence of symptoms, signs, sputum tests, von Pirquet test and radiography. This involves the attendance of the

patient on one occasion to bring sputum, to have a von Pirquet test made and to have his chest examined radiologically and his subsequent appearance in two days' time before the Honorary Officer for examination and final diagnosis.

DEFECTS OF SANATORIUM TREATMENT WITH RELATION TO PREVENTION OF TUBERCULOSIS.

By H. W. Palmer, M.B., Ch.M. (Sydney),
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Every treatment known for tuberculosis has its limitations and is unsatisfactory and the sanatorium is no exception. With the sanatorium there are many weak points, some of which can never be wholly climinated, but we could largely counteract their effects were we only to take proper care.

In the first place we have the character of the disease itself to consider, in that it runs a long course, with periods of good health followed at varying intervals with outbreaks of the disease and even when apparent recovery takes place, relapses may occur at any time till death finally takes place. No two cases are identical and each case must be treated on its own merits.

The fundamental defects of sanatorium treatment for tuberculosis patients are that it is not suitable for all cases, it takes the patient away from his work and home, treatment must be continued for a long time and often does not appeal to the patient as a treatment. It is also apt to make confirmed invalids, while it cannot guarantee a complete cure.

The Function of Sanatorium Treatment.

In dealing with a tuberculosis patient the sanatorium has primarily two functions to perform: the education of the patient and the cure of his disease. Both these functions are intimately related and dependent on each other.

Education.

Education must rank very high in importance as a preventive measure if we are ever to control tuberculosis. Without it we can do little, but the trouble is how are we to bring the general community to a proper knowledge of what tuberculosis is and means. Without doubt, one of the most practical ways must be through the influence of the sanatorium. At first, of course, we only teach the patient and through the patient perhaps his family. Should the patient become well enough to return to ordinary life, he will become a teacher of all with whom he comes in contact, and the value of his teaching will depend on how far he has absorbed the training received at the sanatorium. Not only for the patient's own well being, but because of his example to the community, such training must be complete and lasting in character. The patient must be taught what to do and what not to do and must regulate his whole life to the rules laid down.

Education can be carried out by precept and example and the sanatorium must use both means. Enforcing strict rules, no matter how good they may be, will never get us anywhere, unless their example is convincing. No matter how long a patient may be under strict rules and conform to their ways, unless they appeal to his reason, they will be discarded as soon as he leaves their influence. If we want education to be lasting in character, it must appeal to each patient as essential and only examples that can be experienced, can do this.

If we want new patients to believe in our sanatorium treatment, we must have round them patients who are a good example to them, that is patients who are all improving. If we bring new arrivals into close contact with patients hopelessly affected, it will be impossible for them to gain the confidence and hope they so much require. Now it is well recognized that almost every patient in the early stages improves rapidly during the first few weeks of residence in a sanatorium, and if only such patients were admitted, by hearing and seeing how well the other patients were doing and in a few days, finding they were doing the same, their spirits would rise accordingly and each patient would become to his neighbour a source of stimulation. In this way the whole environment of the sanatorium would be, as it should be, one of hope. If persons in an unsatisfactory state are not admitted, each patient, seeing himself and others improving, gets faith in the treatment. During the whole time he is resident in the sanatorium he regulates his life according to the rules laid down and gradually comes to associate his improvement with the strict enforcement of such rules. In time, improvement becomes dependent on the observance of the rules, so that the patient finally absorbs the knowledge and believes them to be necessary to his own good health and for the protection of those around him.

If, as at present, patients unsuitable to the institution are admitted, such education is impossible; so that selection of patients is an essential.

Cure of the Disease.

What has been said regarding education equally applies to its curative value. If we do not select patients properly, we cannot expect full value in our results. Tuberculosis is a disease of long duration, full of ups and downs, recoveries and relapses, but under ordinary circumstances always with a downward tendency. It is absolutely necessary that the patients' resistance and determination be kept at the highest pitch, if they are to overcome each relapse. If we allow persons whose condition is unfavourable to enter, persons who can never get much better either because of the acuteness of the disease or because tissue damage is already too great, we must lower the tone of the environment and reduce the effectiveness of our treatment. Hope and belief in the treatment is essential. If patients with curable disease see all round them patients failing or dying of the self same disease from which they are suffering, they sooner or later lose heart and either leave the sanatorium too soon or fail to improve as they should.

The Sanatorium Not Suitable for All Patients.

The sanatorium is not suitable for all patients. I have shown that persons with advanced disease or in a dying condition are not suitable for the sanatorium because of their bad influence, but neither is the sanatorium suitable for them. If a patient is dying, it is often cruel to send him to a sanatorium. Situated as sanatoria are away in the country, it often means a rough journey; it takes the unfortunate far from his friends, deprives him of his last moments with them and often the treatment itself inflicts unnecessary hardship. For persons with chronic disease it

is also unsuitable, because there can not be much physical improvement. When they see others improving and they themselves remain stationary, they blame the sanatorium authorities for their want of improvement, demand special attention and frequently become chronic grumblers and as such are hindrances to themselves and all round them.

The sanatorium then should be reserved absolutely for suitable patients. This raises a difficulty. How are such patients to be found and their condition diagnosed. The medical officers of the sanatorium cannot do this necessary work. It must be dependent on the medical profession outside. Recognizing the difficulty of early diagnosis of tuberculosis, we should see that every medical student is well grounded in this subject before graduation. There should be special tuberculosis clinics where patients with doubtful lesions could be kept under close observation by specialists for diagnostic purposes.

Should unsuitable patients be admitted, they should be immediately discharged, no matter how difficult that procedure may be. Because for innumerable reasons this has never been done, the sanatorium has been blamed for being ineffective. If it is necessary to deal with all types of the disease, let us have different institutions for each main type, the sanatorium for patients in the early stages, homes for consumptives in the late stages and with chronic disease and hospices or hospitals for the dying.

Sanatorium treatment takes a patient away from his home and work and if a patient feels well, he often refuses to leave home. The greatest inducement must be that sanatorium is at this time essential and provides absolutely the best treatment. It could only be so if the above conditions prevail. If a patient's family is dependent on his earnings, the present State aid must be made sufficient and all other objections overcome. Everyone should be forced to recognize that patients in the early stages are best treated in sanatorium on account of its training and certainty of cure and that although all patients can be treated at home to a certain extent, those with early tuberculosis can never get the lasting benefit they can at a sanatorium efficiently run.

The sanatorium cannot guarantee a complete cure, which means that no matter how well a patient may have been while in the sanatorium, after care is a necessity. Unfortunately the sanatorium cannot provide proper living conditions or suitable employment for its patients and for after care it must rely wholly on the thoroughness of its training.

Now the mistake in the past has been to consider the sanatorium as a distinct method of treatment for tuberculosis and only that. Little attempt has ever been made to link it up closely with other similar agencies into a comprehensive organization working for the prevention and control of tuberculosis. The requirements and capabilities of the sanatorium even have never been recognized and certainly no efforts have ever been made to make it efficient. We must make the sanatorium efficient and the fundamental requirement is the patient in the early stage. The sanatorium will then become a distinct factor in prevention, for by getting patients early and curing them before tissue damage is done, infection will be prevented and such patients being grounded in sanatorium principles must on returning to ordinary life become living examples and valuable instruments in the education of the general community.

The question now arises how can we find out the patients in the early stage. This opens up the whole question of tuberculosis control. We have in existence ministries of public health with the different public health departments, the medical profession, notification of tuberculosis in certain areas, dispensaries, hospitals and sanatoria, to mention only a few agencies directly dealing with this question. All these agencies must be coordinated if the sanatorium is to get the patient in the early stage nor is it difficult to do this.

The diagnosis of tuberculosis among the general public must be done by the medical practitioner working privately or through the dispensaries or hospitals. Notification is made to the Ministry of Public Health which is then able to identify the patients. If notification ends there, it is useless, for notification must lead to proper preventive measures and treatment of the patient, if it is to justify its own existence. Here then is our opportunity of selecting the patient in the early stages. With notification universally in force, every patient will be identified by the Department of Health. Attached to the Department of Health there should be a tuberculosis clinic capable of classifying each patient and making final diagnosis of doubtful lesion. This clinic would select the suitable patient for sanatoria, while those not suitable would be sent elsewhere.

Seeing how sanatorium treatment depends on coordination with all anti-tuberculosis agencies, one is forced to the conclusion that each agency itself is far from efficient. If a better understanding and coordination is necessary simply for the selection of patients in the early stage, must this not be infinitely more important for the complete control and prevention of tuberculosis in general? Coordination can only be carried out by one authority and as this is probably one of the most pressing public health questions, the duty must fall on the Ministry of Public Health.

Apparently the Ministry of Public Health will only undertake this responsibility when the medical profession are agreed as to the best methods, so that the responsibility now lies in our own hands of indicating what is needed.

THE POSITION THE SANATORIUM OCCUPIES IN THE CONTROL OF TUBERCULOSIS.

By J. Gordon Hislop, M.B., Ch.B. (Melbourne), M.R.C.P. (London),

No longer is a sanatorium regarded as an institution for the cure of consumption, but as the important link in a long chain which forms the organization for the treatment of and control of the disease. Too often in the past, and the present is little if any better, the sanatorium treatment has been asked to relieve a patient who if the activity were to be arrested, would still be a chronic and useless invalid on account of the extent of the pulmonary damage present, a damage that is irreparable. Too often the benefit received from the treatment has been nullified by a return to the previous noxious trade or the unsuitable domestic environment. Too often, again, the maximum degree of benefit has not been obtained owing to

finance regulating the period of stay. For such failures the treatment is not responsible.

There must be a closer connexion between the home, the factories and workshops and the local health officers with the tuberculosis dispensaries which are more useful when forming an out-patient clinic at one of the general hospitals. The link between the dispensary and the general hospital will eventually be a very close one as it is being realized more and more that it is wiser to accommodate febrile patients at a hospital for the early part of the treatment unless special provision has been made for their reception at the sanatorium. The benefit which these patients derive from this, is mostly psychological, a benefit which cannot be disregarded and is frequently seen at Brompton Hospital where the London County Council send some of the patients from their dispensaries. The reception of a febrile or only slightly febrile patient at the sanatorium reduces the required nursing staff and the expenditure considerably.

When the organization includes more than one dispensary, there must be a higher authority which decides which cases are the most urgent when beds are restricted in number, and which decides whether hospital treatment is necessary or whether the patients may proceed direct to sanatorium and such like questions. And thus the true position of the sanatorium is defined, forming as it were the centre point of operations with the hospital lying out a little towards the circumference and acting as a relay station. Closely attached is the dispensary with the local health officers, charitable institutions and factories all in communication. But the organization must not stop here. The sanatorium must be the true centre and from its discharge door, radii must run out along the lines which the patient must eventually traverse.

On discharge a patient must travel along one of a set of six lines, all of which must be guarded. He may return to his own home with the infection apparently arrested, when his route must be made to run over the same lines through which he entered—the dispensary, local health officer to home or factory; he is not to be lost sight of. He may remain at the sanatorium becoming a member of the ground staff controlling the graduated labour or domestic duties may claim a female patient. He may go on to an open air occupation for which the graduated labour has fitted him and all efforts should be directed towards helping him. An excellent example of the farm colony may be seen at our Anzac Red Cross Farm at Janefield and when the time comes as it will do when it is no longer required for the rehabilitation of tuberculous soldiers, it should be included on the civil organization which must one day be undertaken by our Victorian Government.

He may require further special treatment though fit to return to his occupation, as is the case with those treated by means of artificial pneumothorax. The dispensary officers carry on the necessary refillings.

And sixthly there is that class of patient who unfortunately does not respond to any form of treatment. An institution is the proper place for such as these. Put crudely but sincerely, we must have some place where these unfortunate victims can die in comfort without being a menace to the community. Each link in the chain of organization has its particular sphere which is becoming more widely appreciated, and responsibilities which were formerly laid at the door of the sanatorium, are being apportioned out in a more equable manner.

The responsibility of early diagnosis rests with the dispensary and its branchings and this link also shares with the sanatorium the responsibility of prevention.

The scheme of the dispensary is such that individuals may come of their own free will or may be referred by the medical inspectors of factories, general practitioners or local health officers without fee or at a nominal cost. There is a social stigma in being tuberculous; it must be removed and the dispensary officers must undertake publicity campaigns to educate the public to the fact that no stigma attaches to those attending the dispensary; rather that they are social benefactors. The duties of the nurses on the dispensary staff takes them into the homes of the patients where by kindly advice they can do much to insure proper protection of the other inmates. Contacts are welcomed at the dispensary and by the use of tact a nurse can often persuade a contact or a suspect to come under medical supervision at an early stage.

A publicity campaign emphasizing the early symptoms of the disease is badly wanted and would do much to bring sufferers under notice before the damage is done.

When the dispensary is an out-patient clinic at a general hospital, a diagnosis may be made by the use of the whole hospital equipment. Radiology may be resorted to extensively; patients may be referred to the throat and nose clinic or to any of the other special departments. Not only may a diagnosis be made much earlier by these means, but many who are not tuberculous, may be referred elsewhere for treatment with a consequent raising of their resistance against infection. The preventive aspect of the sanatorium arises from the opportunity which the treatment affords, to remove the patients from contact with their relatives and co-workers and from the opportunity afforded to educate the inmates as to how they may lessen the risk of infecting their fellow men by proper disposal of all infective excreta and the developement of regular habits. The responsibility cannot be placed on the sanatorium of controlling the patients after discharge, when in so many cases work is unobtainable and the consequent financial embarrassment restricts them from completely carrying out all the necessary precautions.

Admission into a colony or the absorption of the patient by a charitable institution or the placing of him under the control of an almoner until such time as his physical fitness allows him to earn a sufficient amount will help him enormously to carry out what he has been taught. To-day there are many discharged patients willing to be so controlled who cannot find work and are facing poverty, simply existing on grants from unions or other sources.

A sanatorium which comprises but one block into which all grades of cases are admitted, has many weaknesses and may be said to have failed in comparison with one in which the inmates are graded into three classes. Or, to put it in another way, an organization with one sanatorium will produce little result in comparison with one with three grades of sanatoria.

No. 1 grade should be reserved entirely for the suspect. Every observer has experienced difficulty in deciding whether a person is phthisical, especially when the sputum does not contain tubercle bacilli or there is no sputum, yet history, physical examination and radiological interpre-

tation suggest the presence of infection. The type of patient so often encountered, in whom loss of weight has occurred and lassitude is complained of with apparently no physical reason, is the type that are most suitable for this preventive sanatorium. In many of these patients but a short period will be all that is necessary to restore them to health. Further still, there are many who, while being suspect, do not themselves feel ill enough to consent to admission to an ordinary sanatorium, but will consent to a period of residence at such a sanatorium which is nothing more than a convalescent hospital where the ordinary routine of observation, rest, fresh air and exercise is carried out.

No. 2 grade is the sanatorium as it is popularly known to-day where those with tuberculous sputum are admitted. Here the strict observation and periodic examination, both physical and radiological, are enforced and the graduated labour system carried out. In an up-to-date sanatorium to-day, beyond rest, controlled work and tuberculin therapy artificial pneumothorax therapy is a *sine qua non* and is becoming more widely used in cases of pleural effusion and tuberculous empyema, as well as for the curative treatment of pulmonary tuberculosis.

No. 3 grade is the home for patients with advanced disease, those whom none of our present methods benefit, but who would be less numerous were the diagnosis made earlier and the organization as complete as indicated. Whilst No. 1 and 2 grades may be situated within the same area, though distinctly separated, No. 3 is preferably removed from the others for the reason that it soon becomes known that its inmates are bedridden and hopeless; if it is in close proximity to the ordinary sanatorium it is viewed with feelings akin to horror. The psychology of the consumptive must be studied and, in some cases, it becomes necessary, even with the *spes phthisica* present, to hold constantly before the mentality an improvement in condition—this the stepping from grade to grade that the controlled labour often fulfils.

In criticizing a single sanatorium as opposed to the sanatorium system, one must always bear in mind whether that institution is labouring under the difficulties of its sponsors having been the victims of Otto Walther's possibly well meant advice. More and more climatological study is emphasizing the fact that a sanatorium must be sheltered and protected from winds. Dettweiler's sanatorium at Falkenstein was exposed to rain-bearing winds, was not a success and was afterwards removed to a sheltered spot at Ruppertshain, whilst Otto Walther's at Nordrach was a signal success, Walther visiting over two hundred possible sites before choosing Nordrach. Too long have we been labouring under the dictum of fresh air first and site second; in future more attention must be paid to the site.

The organization thus presented for consideration is the result of a study of the present day requirements, the results and the failures of individual systems and the inspection of many organizations for the control of tuberculosis in England and on the continent. Nowhere will the complete chain with all the necessary requirements in all the links be found, but the one nearest to completion is that of the London County Council. It is not an organization of dream-like consistency but is coming, in London quickly, in other places more slowly. When it does come, it will be realized that many of the weaknesses which are now present in our sanatorium systems, are no longer obvious, proving that many of the present day weaknesses are not the property of the sanatorium but of the incomplete organization.

DIPHTHERIA—INCIDENCE AND MORTALITY IN AUSTRALIA.

By W. C. Sawers, D.S.O., M.B., Ch.B., D.P.H., D.T.H.,
Melbourne.

At the commencement of a discussion on diphtheria it might be of interest to visualize a few of the recent statistics of this disease in Australia. To meet this possible demand the following few charts and graphic representations are put forward.

The statistics on which Charts I. and II. are based were supplied by Dr. Holmes, of the Commonwealth Health Department, to whom are also due the model representations shown; Chart III. and data for Charts V. and VI. are drawn from figures published in *Health*, March, 1923.

For Chart IV. and its data, I am indebted to Dr. Morgan, of the Commonwealth Serum Laboratories.

Death Rates.

Chart I. shows death-rates per hundred thousand living for the Commonwealth for years 1890-1922.

The first great fall 1894-1896 is undoubtedly due in great part to the introduction of antitoxin.

Since then there has been a greatly lowered but nevertheless steady death rate ranging between six and seventeen per hundred thousand. A rise is seen for the year 1921, followed by a sharp fall in 1922.

This indicates that a definite death rate is still to be looked for despite antitoxin, although the treatment by antitoxin has produced a considerable reduction in the death rate. Perhaps in the future the universal introduction of the active immunization by injection of toxin-antitoxin mixture of all children yield a reaction to the Schick test may reduce this death rate to almost negligible size.

Incidence of Diphtheria.

Chart II. shows the number of cases of diphtheria notified per hundred thousand in Victoria from 1890 to 1922. A sharp rise will be noticed in 1910; this may be due to greater care in notification, for the rise in death rate in 1921 is accompanied by a rise in notifications and there is a corresponding fall of both cases notified and deaths in 1922.

Chart III. gives the total number of cases for the Commonwealth in four weekly periods during 1922. This chart depicts the rise in diphtheria incidence in the months of March, April and May and shows a very great decrease in December.

Chart IV. shows the average monthly case incidence of diphtheria for the Commonwealth and the States over varying periods of years.

CHART 1.
DIPHTHERIA
Death Rates per Hundred Thousand living - 1890-1922.
COMMONWEALTH

CHART 2.
Diphtheria Cases notified per Hundred Thousand in Victoria
1890 - 1922.

CHART 3.
Total Diphtheria Cases for Commonwealth
in 4-weekly periods. 1922.

CHART 5.
Diphtheria Case Mortality per cent. for 1922.
for various States & Commonwealth.
Q'land.
W. Aust.
N.S.Wales.
S.Aust.
Victoria.
Tasmania.
(Commonwealth.

CHART 6.
Diphtheria Cases per Hundred Thousand
of population.
for various States. 1922.
Q'land.
W. Aust.
N.S.Wales.
S. Aust.
Victoria.
Tasmania.

For New South Wales there is an eight year period from 1913 to 1920; for Victoria there is a five year period from 1916 to 1920; for Queensland there is a four year period from 1917 to 1921; for South Australia there is a five year period from 1916 to 1920; for Western Australia there is a five year period from 1915 to 1919 and for Tasmania there is a two year period during 1919 and 1920.

In this chart the highest point of case incidence in all States except Tasmania is shown about May; in the case of Tasmania the figures shown are for two years only. The 1922 chart for total cases for the Commonwealth shows the maximum rise about one month earlier.

Case Mortality.

Chart V. shows a comparison for the various States and the Commonwealth of the case mortality for 1922.

The striking feature is the low mortality figure for Victoria; the reason for this may be a less virulent organism or more probably increased facilities of treatment owing to the greater density of population and therefore more immediate medical attention.

Chart VI. shows the number of cases per hundred thousand of population in 1922 for various States.

The rise on going from north to south is striking. This

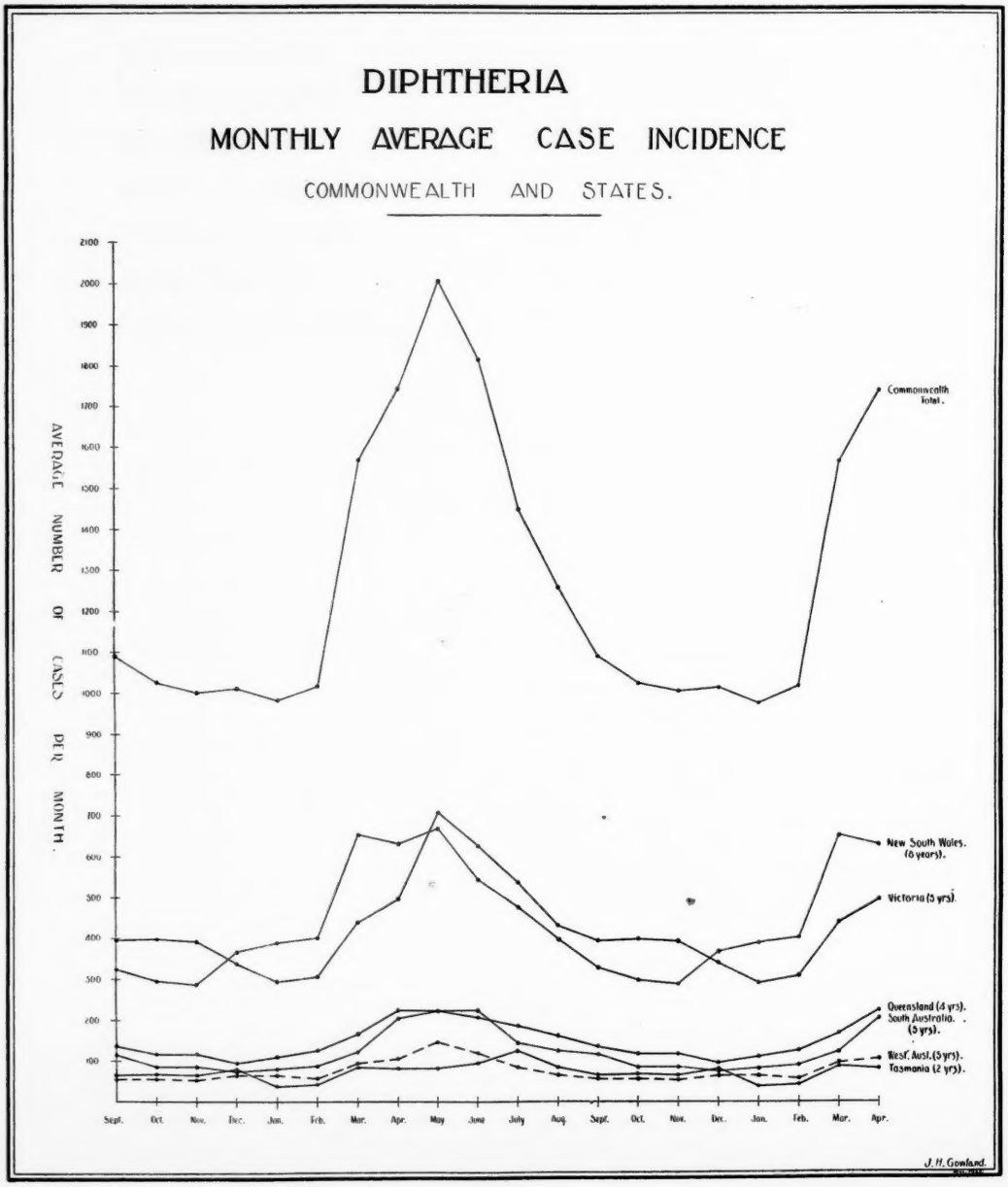
DIPHTHERIA
MONTHLY AVERAGE CASE INCIDENCE
COMMONWEALTH AND STATES.
AVERAGE NUMBER OF CASES PER MONTH.
Commonwealth total.
New South Wales. (8 years).
Victoria (5 yrs).
Queensland (4 yrs).
South Australia. (5 yrs).
West. Aust. (5 yrs).
Tasmania (2 yrs).
Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.
J. H. Gowland.

CHART IV.

chart also does not bear out the conclusions of Dr. Arthur Newsholme "that diphtheria is relatively a continental rather than an insular disease." ("The Bacteriology of Diphtheria" edited by G. H. F. Nuttall and G. S. Graham Smith).

TABLE I.

Data for Charts 1 and 2.

Year.	COMMONWEALTH. Death Rates per Hundred Thousand living.	VICTORIA. Cases notified per Hundred Thousand.
1890	60	140
1891	46	140
1892	45	140
1893	36	140
1894	31	140
1895	19	130
1896	12	130
1897	16	130
1898	17	130
1899	12	130
1900	8	120
1901	9	140
1902	6	130
1903	9	110
1904	11	180
1905	8	100
1906	8	70
1907	10	130
1908	12	130
1909	11	120
1910	13	180
1911	14	380
1912	16	390
1913	16	380
1914	14	340
1915	14	310
1916	18	380
1917	13	290
1918	12	460
1919	10	270
1920	15	430
1921	17	610
1922	8	339

TABLE II.

Data for Chart 3.

COMMONWEALTH. Total Cases in Four-weekly periods. 1922.

Four-weekly periods.	Commonwealth.
Jan. 1-28.	1,017
Jan, 29—Feb. 25	1,119
Feb. 26—Mar. 25	1,631
Mar. 26—Apr. 22	1,802
Apr. 23—May 20	1,699
May 21—June 17	1,412
June 18—July 15	1,159
July 16—Aug. 12	944
Aug. 13—Sept. 9	831
Sept. 10—Oct. 7	754
Oct. 8—Nov. 4	610
Nov. 5—Dec. 2	626
Dec. 3—Dec. 31	552

TABLE III.

Data for Chart 5.

Diphtheria Case mortality per cent. for 1922, for VARIOUS STATES AND COMMONWEALTH.

Data for Chart 6.

Diphtheria Cases per Hundred Thousand of population for VARIOUS STATES.

1922.

State.	Case Mortality per cent.	Cases per 100,000 of population.
New South Wales	3.75	196
Victoria	1.87	339
Queensland	4.5	169
South Australia	3.9	306
Western Australia	2.9	178
Tasmania	3.4	779
Commonwealth	3.1	260

MONTHLY INCIDENCE OF DIPHTHERIA FOR THE LAST FIVE YEARS IN THE STATES OF AUSTRALIA (Tasmania for 2 years).

TABLE V.

TASMANIA

Month	1919	1920
January	50	29
February	54	29
March	111	60
April	92	73
May	98	65
June	95	99
July	122	128
August	92	73
September	50	74
October	56	81
November	44	87
December	51	103

TABLE VI.

WESTERN AUSTRALIA

Month	1915	1916	1917	1918	1919
January	71	56	81	52	70
February	59	47	59	60	66
March	117	79	65	120	118
April	119	79	81	145	98
May	150	94	91	223	158
June	140	73	86	159	123
July	95	54	50	145	80
August	63	42	59	105	56
September	49	51	51	81	43
October	48	62	64	60	48
November	75	54	59	44	31
December	59	66	54	83	80

TABLE IV.

Statement showing average number of cases for each month reported by each State for the periods shown hereunder.

MONTH.	NEW SOUTH WALES Monthly av'age over period of 8 years.	VICTORIA Monthly av'age over period of 5 years.	QUEENSLAND Monthly av'age over period of 4 years.	S. AUSTRALIA Monthly av'age over period Jan.–June 6 yrs July–Dec. 5 yrs.	W. AUSTRALIA Monthly av'age over period of 5 years.	TASMANIA Monthly av'age over period of 2 years.	TOTAL for Commonwealth
January	389.125	291.8	110.75	80.1	66	39.5	977.275
February	400.125	304.2	123.75	91	58.2	41.5	1018.775
March	652.5	439.6	167.75	123.3	99.8	85.5	1568.45
April	630.75	496.8	222	204	104.4	82.5	1740.45
May	668	706.2	222.5	223	143.2	81.5	2004.4
June	544.125	628.4	202.25	228.5	116.2	97	1816.475
July	478.75	539.2	182	143.2	84.8	125	1452.95
August	397.25	430.4	160.25	124	65	82.5	1259.40
September	327	394.4	134.25	117.6	55	62	1090.25
October	295.375	398	117.5	88	56.4	68.5	1023.775
November	288.625	390.4	117.25	86.6	52.6	65.5	1000.975
December	365.5	338.2	98.75	70.4	68.4	77	1018.25

MONTHLY INCIDENCE OF DIPHTHERIA FOR THE LAST FIVE YEARS IN THE STATES OF AUSTRALIA (Tasmania for 2 years)

TABLE VII.

QUEENSLAND

Month	1917–18	1918–19	1919–20	1920–21
July	175	365	79	109
August	155	364	68	54
September	141	209	98	89
October	156	172	76	66
November	130	167	77	95
December	139	111	53	92
January	170	96	73	104
February	197	159	56	83
March	227	294	86	64
April	270	431	121	66
May	279	338	158	115
June	351	242	118	98

TABLE VIII.

NEW SOUTH WALES

Month	1913	1914	1915	1916	1917	1918	1919	1920
January	475	374	362	598	399	305	284	316
February	476	320	454	596	408	320	209	418
March	659	607	739	912	775	537	317	674
April	566	631	576	767	847	694	319	646
May	682	711	587	925	808	669	337	625
June	675	664	536	579	647	535	262	455
July	658	566	507	482	549	499	207	362
August	508	545	447	442	325	474	146	291
September	495	278	340	439	284	336	202	292
October	433	290	321	314	264	274	170	297
November	366	296	376	260	255	273	179	304
December	474	549	593	274	244	234	194	362

TABLE IX.

MELBOURNE

Month	1916	1917	1918	1919	1920
January	208	259	237	408	347
February	300	257	283	316	365
March	439	348	407	325	679
April	534	373	494	320	763
May	873	450	702	347	1159
June	545	411	1031	556	599
July	497	544	653	361	641
August	450	288	709	346	359
September	489	267	559	341	316
October	330	267	473	257	363
November	510	267	464	433	278
December	274	368	503	274	269

TABLE X.

ADELAIDE

Month	1916	1917	1918	1919	1920	1921
January ..	53	71	66	95	63	133
February ..	61	80	84	66	127	128
March	93	77	120	124	164	162
April	250	106	100	185	189	394
May	271	175	118	185	209	380
June	291	172	209	118	170	411
July	182	107	178	128	121	
August	148	92	162	121	97	
September ..	127	133	121	102	105	
October ..	83	85	104	65	103	
November ..	68	76	103	88	98	
December ..	42	82	97	51	80	